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Welding operators at work on the Ogden Slip approach to new outer drive bridge over Chicago River—Photo, through courtesy of The Teleweld Co. and General Electric Co.

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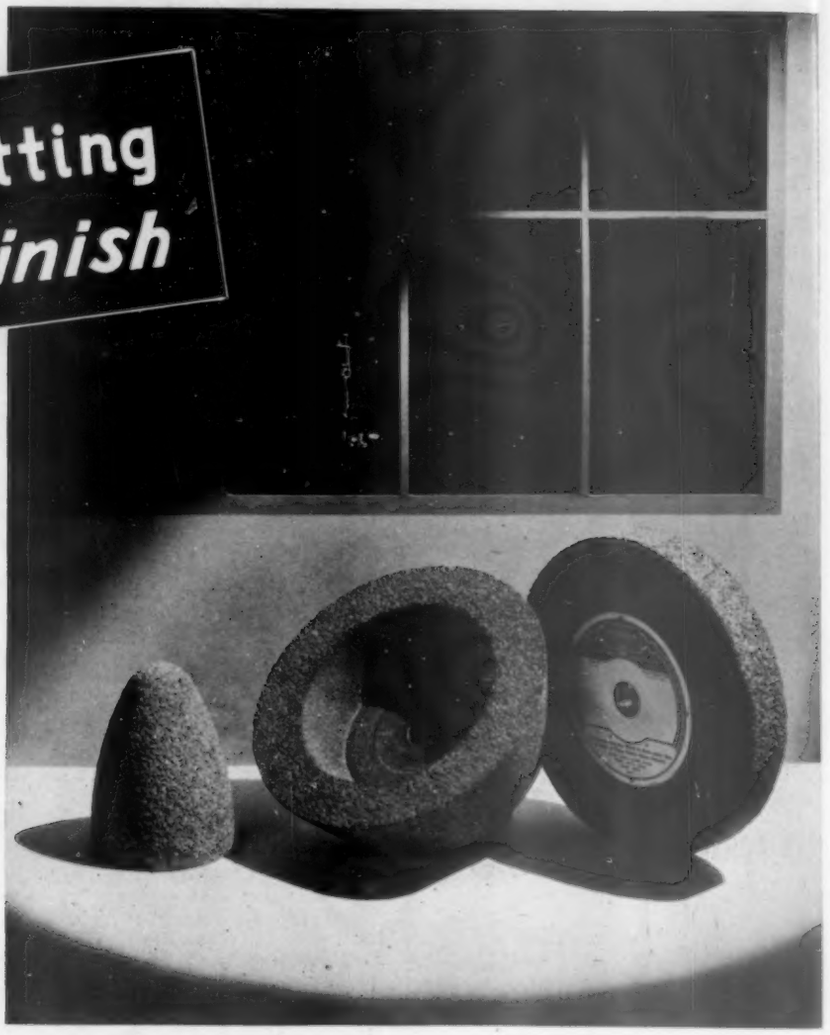

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Higher Living Standards

★

OUR GREATEST educational deficiency at the present time is the general lack of understanding of economic fundamentals. Only through educational processes carried out in an orderly manner will labor and capital reach a better understanding. Various attempts to employ brute force (a reversion to anarchy) have in the past proved to be dismal failures. The difficulty is that economics is a highly complex subject and its method of treatment, both in the classroom and in text books is much too academic for the man in the street to grasp. There is a bright side to this serious problem, however, because the basic economic principles are fairly simple.

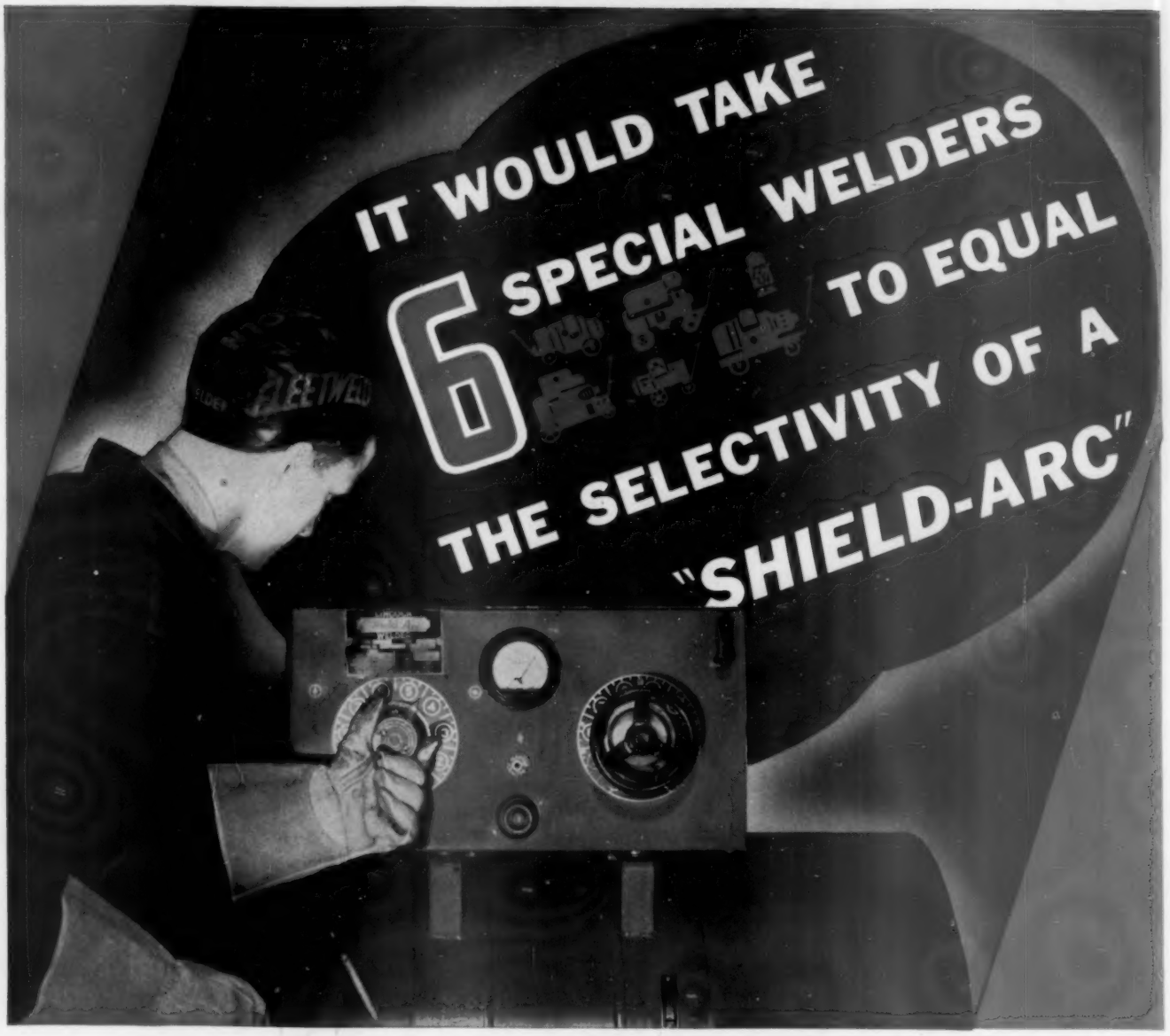
Men prominent in the business world are keenly alive to this urgent need for a wider dissemination of knowledge concerning basic economic fundamentals. Business realizes that it has a definite responsibility toward the public in publicizing the fundamental objectives of business and its public benefits. Public relations experts are being called in and their job is becoming increasingly more important as the need for this activity becomes apparent.

What is the objective of all business effort? Ordinarily the answer is quickly given—the desire for profit. This, however, is not the only aim of business. It is generally recognized that a second and most important aim of business is to increase the average standard of living. However, if this is to be accomplished in a production and exchange economy such as we have, there is only one way higher living standards can be reached and that is by stepping up the productivity of labor. Studies made by the Brookings Institution, Washington, D. C., indicate that during the three decades 1900 to 1930, per capita real income in the United States advanced approximately 30 per cent. In other words, we moved forward in the scale of living about 1 per cent per year, as measured in terms of real income.

Most of the credit for achieving higher living standards belongs to the engineer because without him technical improvements which increase labor efficiency could not be realized. Dr. Harold G. Moulton, president of Brookings Institution, in addressing the mid-winter convention of the A. I. E. E. a few months ago clearly set forth the problem which the engineer has to wrestle with. If the following simple statement of economic facts could be widely disseminated and understood, most of our labor difficulties and economic problems would disappear. Here is Dr. Moulton's formula for achieving higher standards of living:

"First, the process of raising the standards of living of wage earners necessarily involves increasing the ratio between wage rates and prices. If the wage earner gets more dollars and prices remain unchanged, his purchasing power is expanded. If he gets the same number of dollars and prices decline, his purchasing power is expanded. But it can be expanded only by increasing wages in comparison with prices.

"Second, an increase of wage rates relatively to prices depends fundamentally upon increasing the efficiency of production. Only thus will the means be available with which to pay higher real wages and provide more goods and services. Accordingly, there must be a constant acceleration of technical advances, improvement in management, increased labor efficiency, and so forth. Any practices or policies that tend to work in this direction may be regarded as economically sound, and any that tend to work in the opposite direction must be pronounced economically unsound."



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★ Part of the huge water distribution system being built in California by the Metropolitan Water District

Operator is "guniting" the field-welded pipe joint.

By CLIFFORD W. TABER

THE ETERNAL QUEST for water in the Southwest is an intensely interesting drama, and welding is one of the stars. The ten-mile all welded steel siphon across the Santa Ana River valley near Riverside, Calif., is one of the features of the Colorado River aqueduct distribution system.

The pipe diameters vary from 9 ft. 8 in. to 11 ft. 6 in., and the shell thicknesses vary from 17/32 in. to 31/32 in., according to the operating head, which is 20 ft. at Pedley Hill and 482 ft. at California Avenue, near Arlington. Over 40 linear miles of single-pass butt welds made by the automatic metallic arc were required in the fabrication of the 1,660 pipe. Each pipe was 33 ft. 4 in. long and the total weight was 31,700 tons. The field joints, welded manually, required 75 tons of shielded arc electrodes for the multi-pass fillet welds.

The general contract for the all-welded siphon, of the Metropolitan Water District distribution system was awarded to Western Pipe and Steel, Los Angeles, Calif., for $4,207,038.

In the Los Angeles basin there are 2,200 sq. mi. of first-class land. In 1900 the population was 235,000, and in 1936 it was estimated at 2,800,000, a tremendous increase and a drain on resources to keep abreast of public needs. Los Angeles has an annual rainfall of about 15 in. and the rivers of Southern California are short and, except in flood season, dry. Therefore it was necessary for the City of Los Angeles to build the 233-mile Owens River aqueduct into the high Sierras to supplement the supplies from local wells. However, the amount of water needed from these sources exceeds the average yield and it is estimated that double the present supply will be needed in the near future. It was therefore imperative to find other sources.

Metropolitan Water District

The Metropolitan Water District of Southern California, the agency of 13 cities in Los Angeles and Orange counties, the Los Angeles basin, was formed in 1928 to supply water for domestic and industrial uses. The first objective of this organization was the construction of the 242-mile Colorado river aqueduct, designed for a capacity of 1,605 cu. ft. per sec., over one billion gallons per day. The storage of Colorado River flood waters by the mighty Boulder Dam made this project possible.

The aqueduct intake is located near Parker, Ariz., 155 miles downstream from Boulder Dam, where the Bureau of Reclamation is constructing the Parker Dam for the District. From here, by use of Boulder power, the water is lifted a total of 1,617 ft. in five separate lifts, thence by gravity to the termination of the main aqueduct at Cajalco Reservoir, 50 miles east of Los Angeles. From Cajalco the water will be conveyed by gravity through the distribution pressure lines to the consumer cities.

Pipe Fabrication

The pipe was fabricated in Los Angeles by Western Pipe & Steel Co. and Consolidated Steel Corp. as subcontractor. Specifications required that the steel plates meet the requirements of the American Society for Testing Materials designation A10-34 mild steel plates, or at the contractor's option, designation A78-33 steel plates of structural quality for forge welding, grade B. All steel to be of good welding quality and manufactured by the open-hearth process.

For each pipe four plates 100 in. wide and of suitable length were cold-rolled into true cylinders of the required diameter. The longitudinal seams were butt-welded, before the cylinders were tacked together for the circumferential butt-welds. The longitudinal seams were staggered at 30 deg. on top of the pipe. All the butt-

welds were made in one pass by an automatic arc, completely shielded in powdered flux.

Small plates of material identical with that used for the pipe were tack-welded to both ends of one or more longitudinal welds for every 400 linear ft. of combined longitudinal and circumferential weld. These plates were of sufficient width to provide for at least two tension, one bend, and one nick-break test specimens. Results were required to conform to the API-ASME code for unfired pressure vessels. Such portions of the welds designated by the engineer were radiographed and if found defective were chipped out and rewelded.

Stress Relieved

After completion of all shop welding, including any appurtenances, each section of pipe was stress relieved. This was done by heating the entire structure uniformly to between 1,100 deg. and 1,200 deg. F., in a furnace with temperature controls. The heat was brought up slowly to the required temperature and held for at least 40 min., and then allowed to cool in a still atmosphere.

To prevent sag or distortion in the furnace, to keep the pipe round in transportation and during the guniting operation, the pipe was braced at both ends by steel rings and cross braces. When the pipe was laid, the rings and braces were taken out and returned to the shop to be used again.

Each section of pipe after stress relieving was subjected to a hydrostatic test. The pressure was held a sufficient time to permit inspection for leaks, undue distortion, or other defects. After the hydrostatic test, the pipe was sand blasted to bright metal free from mill scale, rust, or other foreign matter.

Protective Coating

Enamel.—The pipe was lined with a coating of coal tar enamel which was applied centrifugally in the shop. To insure a perfect bond, all surfaces to be coated with coal tar enamel were first given a coat of coal tar primer. While the pipe was revolved it was heated by natural gas flames to a uniform temperature of 190 deg. F. Hot enamel, 475 deg. F. was poured from a spout, which was synchronized with the revolving pipe so that a continuous glossy coating of 3/32 in. minimum thickness was spread on the hot steel.

The field joint was applied by hand after the steel had been cleaned, all rough spots bobbed down, and a coat of coal tar primer was brushed on. The enamel was heated in batch-type electric kettles and smaller electric kettles were used in the pipe to keep the temperature up to 475 deg. F. Twelve hundred tons of coal tar enamel was used on the complete job.

Gunite.—The pipe was loaded one section to a flat car and shipped by rail to a centrally located yard in the field. A specially constructed pipe handler mounted on crawlers, capable of straddling a flat car and pipe, was used for unloading in the gunite yard.

A ¾ in. coating of gunite was applied directly to the steel over a reinforcement of wire mesh while the pipe was revolved on dollies. The field joint, of course, had to be shot in position. When designated by the engi-

(Upper Left) Placing one of the big sections where the going was pretty rough. (Upper Right) Pipe was carried over the Santa Ana River on a three-span 541 ft. steel bridge. (Bottom Center) Putting last section in place on top of Pedley Hill. Bulkhead at left is for hydrostatic test of first half of section.

(Upper Left) Welding in the "bell hole"—Note the gunited coating and wire reinforcement. (Upper Right) Welder working outside on steel scaffold. (Bottom Center) Welders on the night shift working in the "bell hole."

neer, due to the corrosive condition of the soil, a 3/32 in. thick coating of coal tar enamel was applied to the pipe exterior before guniting.

Pipe Laying

The pipe was transported from the gunite yard to the pipe line by low bed semi-trailer trucks. A Marion electric powered crawler crane working on wooden mats of 8x12's along the trench bank was used for pipe laying.

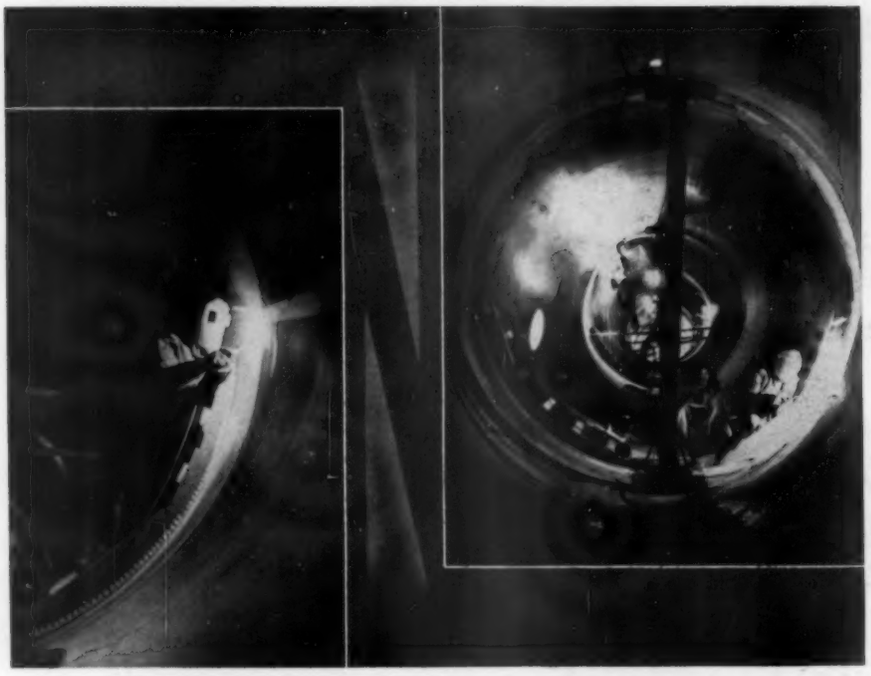
When the pipe was lowered in, the bell end was allowed to lower first and was lapped 3½ in. on the spigot end of the pipe in the trench. A ⅝ in. x 6 in. tack-weld was placed on top of the pipe before it was completely lowered, this tack acting as a hinge. Then, as the spigot end lowered, it would force the bell over the spigot of the other pipe.

By means of a hydraulic jack on the end of a 6 in. x 6 in. stull, the fitters could jack out any diameter and tack-weld it, a stull was placed, and the jack taken out. These stulls were 6 in. x 6 in. and 14 in. shorter than the pipe diameter. Maple header blocks made of 6 in. x 6 in., 2 ft. long, and formed on one side to fit the pipe, were placed at right angles on the top and bottom of the stull. Hardwood wedges were driven between the stull and the bottom header block to make the stull secure. All stulls were left in the pipe until the back-fill was completed. Stulls were always placed at the joints in a vertical position except when concrete structures were placed around the pipe.

Welding Procedure

To make the welded joint as good as or better than the parent metal, procedure control was necessary. All the welding was done by experienced operators who were required to meet the qualification test for welders as specified in paragraph W-451 of the API-ASME code for unfired pressure vessels. Tests were made with similar machines and the same shielded arc electrode as used on the line. Tests were made in the presence of the engineer who determined the quality of the work done.

Quality of the field joint weld was determined by visual inspection by men capable of making the weld themselves, and trained to recognize quality of weld. When, in the opinion of the inspector, the weld did not meet the requirements of the specifications, the faulty parts were chipped out and re-welded. If the weld was not uniform in appearance and size, another finish pass was required. Any welder was subject to dismissal, or to a retest at



(Left) Making the inside bell and spigot lap weld. (Right) Welding the inside fillet joint. Note folding scaffold and 6 in. by 6 in. stulls.

any time if his work did not meet specifications.

A definite number of passes were required corresponding to the weld size, approximately ⅛ in. per pass, with the first two passes "downhill" and the rest "uphill." This kept all welds uniform and lessened the danger of concentrated stress due to heavy passes. Each pass would tend to wash out slag and pin holes and partially anneal the former. The number of passes in a weld has a definite effect on the grain size, the greater number of passes will have small grains which gives a higher tensile strength, but probably not as ductile as a large grain weld.

Down and Up

"Downhill" welding starts at the top and progresses down just fast enough to keep the slag of the shielded arc rod from running into the molten pool. The first pass, really a stringer bead, is carried without oscillation directly in the corner of the fillet. The second pass completely covers the first and required slight oscillation to get good penetration on the sides.

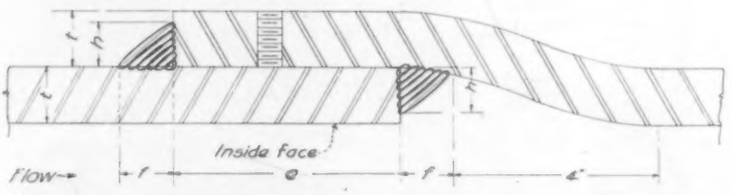
The "downhill" pass has the definite advantage, that it is impossible to carry much metal down, therefore a greater number of passes are required which tends toward a finer grain size. However, the wide "downhill" pass is very difficult to carry so the larger passes were run "uphill."

"Uphill" welding starts at the bottom and progresses to the top. The "up" pass is actually a series of beads carried back and forth across the weld, each bead overlapping the former. On the bottom and top, due to the angle of the fillet weld, the metal is carried in one direction; but on the sides where the fillet is nearly a vertical weld, metal can be carried back and forth.

In either case, great care must be taken to wash out the slag and to get good penetration without undercutting. Undercutting can be overcome by properly setting the welding current and proper manipulation of the electrode. Movement of the rod up and back into the weld at the corners, with a slight hesitation at the sides, will let the cut fill up. Undercut or knots at edge of the weld are points of concentrated stress. Changes from one section to another should be gradual. Each pass was completed, thoroughly wire brushed, and scraped, before another pass was started; in every case the pass around the circumference was completed before another pass was put on. Stress was minimized by this distribution of heat. Number 5, 3/16 in. V electrodes were used on all the field work. Larger rods are not practical because of the constant change in welding position around the circumference.

When the inside and outside welds were finished on a joint they were tested by forcing soap solution, at 100 lbs. hydrostatic pressure, into the annular ring formed by the lap. At the quarter points on the circumference of the bell end of each pipe was a ¼ in. threaded hole to which were

BELL AND SPIGOT FILLET WELD



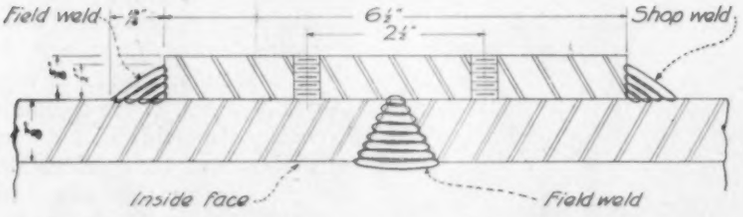
f	e	h	r	passes
5/8 to 1 1/16 incl.	3	3/16	11/16	4
23/32 to 25/32 incl.	3 1/4	5/8	3/4	5
13/16 to 7/8 incl.	3 1/2	11/16	13/16	6
29/32 to 31/32 incl.	3 3/4	3/4	7/8	7

For seams joining plates of different thickness use the larger values.

Drill and tap in bell end, before welding, 4 holes for ¼" pipe equally spaced around circumference.

(Above) Details of the bell and spigot fillet weld.

V-BUTT WELD ON RIVER CROSSING



Butt strap to be in two pieces; one piece shop welded to lower half of pipe section and the other piece shop welded to upper half at adjacent section. V-butt field weld to be completed before making the butt strap field weld. Each pass not to exceed ⅛" in thickness. Pipe to be spaced so first pass will penetrate butt strap. Drill and tap ¼" holes in butt strap for soap solution test.

(Left) Details of the V butt weld on Santa Ana River crossing.

fastened the testing apparatus. A plug was screwed into the hole after testing.

Welding Scaffolds

The welding crew averaged 40 welders working in two shifts. To secure the best workmanship, most economically, it was quite important to have suitable scaffolds and accessories to give the welders the best possible working conditions. As the field joints had to be made in the "bell hole" position without turning, the weld had all the variations from flat through vertical to overhead.

The outside welders worked in pairs and because of the large diameter of the pipe, they could work on opposite sides without interference. Scaffolds for the outside were made of 1½ in. angle iron, similar to a ladder, with the top formed to fit the pipe. Two scaffolds on each side with loose boards that could be placed between them on the scaffold rungs, gave each welder opportunity to adjust it to best suit his needs.

A pair of scaffolds was fastened together over the top of the pipe by cable. After the weld was completed, the helpers could pull up the scaffolds, carry it to the next "bell hole" and set it up in about 30 min. Five pairs of welders working on consecutive seams, generally composed the outside crew.

The inside welders worked singly on wooden scaffolds about 30 in. wide. These scaffolds had tin bottoms to keep sparks and hot welding rod stubs off the enamel finish. Planks could be placed across the pipe on the scaffolds' rungs to any desirable height. After the weld was completed, the scaffold was folded at its four hinged joints and carried forward. The inside crew generally worked on eight consecutive seams.

Equipment

Transformers with panels of fuse blocks and individual switches for the welding-machine hook-ups were mounted on trailers, so that they could be moved along the line. Cables for light inside the pipe and for night work also were hooked to the transformers. Electricity was furnished by a 11,000-volt temporary line constructed along the right-of-way.

The 25 direct-current, electric-driven generators were skid-mounted and could be towed along the side of the trench by a tractor. One of the features of the welding machines was the remote control. The generator has a small reversible motor geared to the voltage rheostat. Two small wires which are imbedded in the welding cable insulation go from the motor to a push-button box that the welder can have at hand for close adjustment.

Pedley Hill

The line traversed comparatively level country through approximately 3 miles of orange groves and 7 miles of open farming country, except for Pedley Hill, elevation 1,150 ft., 350 ft. above the valley and within 20 ft. of the hydraulic gradient. The south side of Pedley Hill has a grade of 21 deg. and the north side has a grade of 24 deg. Track was laid up the south slope and in the bottom of the trench on both sides. By a stiff-leg boom, the pipe was unloaded from the transport truck onto a cradle car. The car was drawn to the top of the hill by an electric cable hoist and switched to either north or south trench. Pipe placing was done with hydraulic jacks. To facilitate working on the steep grade, rope hand-rails and cleated boards were placed on top of the pipe.

Santa Ana River Crossing

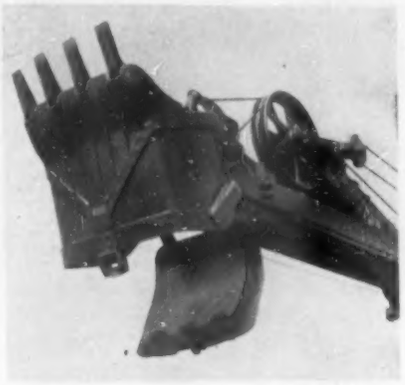
The pipe crosses Santa Ana River on concrete piers and a 550-ton, 3-span steel bridge 544 ft. long, fabricated and erected by Consolidated Steel Corp. This section of exposed pipe is mounted on ring girders which are supported by vertical rocker arms. To permit expansion and contraction, midway in this section is an expansion joint so that the pipe and bridge can move independently.

Vee butt welds with butt straps were used because of the limited space for joining. Temporary track was laid the full length of the bridge, the pipe was placed by a stiff-leg boom onto a saddle car and rolled into place on falsework exactly to grade, line, and station. When given the O. K. by the engineer, the fitters laid-up the joint and securely tack-welded it. Accurate check was made by strain gages and the rocker arm bases were shimmed up so that the loading will be equal on all points when the pipe is full of water.

A minimum of eight passes, either "uphill" or "downhill" on the first passes and all finished passes "uphill," was required on the Vee butt weld. This pipe had a plate thickness of ⅞ in. and a diameter of 9 ft. 8 in. Even-numbered passes were peened to relieve partially the stress due to welding. The outside butt straps were fillet welded.

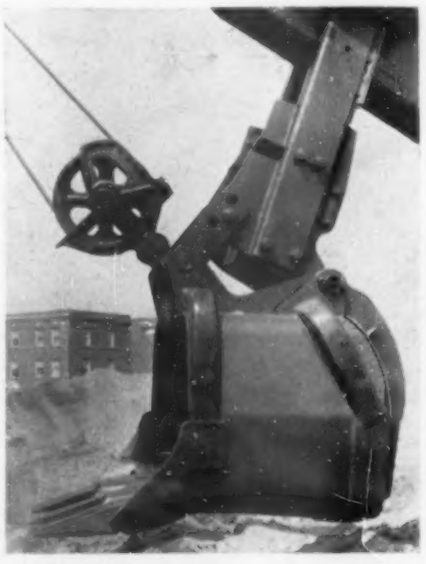
Welded Alloy Steels Make Better Power Shovels

★ Modern alloy steels and welded construction have been combined to produce a new power shovel featuring smooth operation; high speed, good mobility, and adequate strength to give steady dependable service in the heaviest kind of digging. This new 1¼ yd. excavator is designated Model 33-B by its manufacturer, Bucyrus-Erie Co., South Milwaukee, Wis.



Bottom view of 1¼ yd. welded dipper—Note sockets for patented inserted teeth.

Among the welding features on the Model 33-B power shovel are three which definitely indicate superiority: (1) A welded box-girder boom, light in weight for speedy operation, yet strong enough for enduring service; (2) Manganese steel dipper, "V" type front, with sockets for patented inserted teeth, curved plate door; (3) Snappier swing action and high speed output by elimination of unnecessary and power-consuming weight.



Close-up of welded manganese steel dipper.

Review of metallurgy
and physical properties of

Low-Alloy and Stainless

★ Practical suggestions for oxy-acetylene welding of stainless steels — Annealing welds improves corrosion resistance

WHEN INNOVATIONS in the metal industries have progressed to such a stage of acceptance that they affect commerical trends and industrial practice, they represent definite advances. This is particularly true of the low-alloy, high-tensile steels which are being so widely used in mobile units and structures such as railroad and mine cars, dipper buckets, and mine skips.

Since these steels have gained recognition for the steady advances they have made in numerous applications, it remains only to give them a name comparable to the "automotive steels." There are certain objections to the term "low alloy," and the use of an avalanche of trade names is apt to be somewhat confusing. In addition, there is a certain awkwardness in continual reference to "steels-containing-small-amounts-of chromium, manganese, and copper," "chromium, manganese, silicon, and vanadium," or whatever the analysis happens to be. For want of a better name, the term "mobile-structure steels" is suggested and will be used here, with the understanding that mobile-structure steels, like the automotive steels, are highly useful both in mobile assemblies and in many stationary applications.

The limited alloy content of these steels does not add greatly to their cost, and yet appreciably increase their strength, toughness, and in many cases, their resistance to corrosion. As a result it is possible to utilize these steels in structures that are light in weight, and yet relatively strong and wear-resistant.

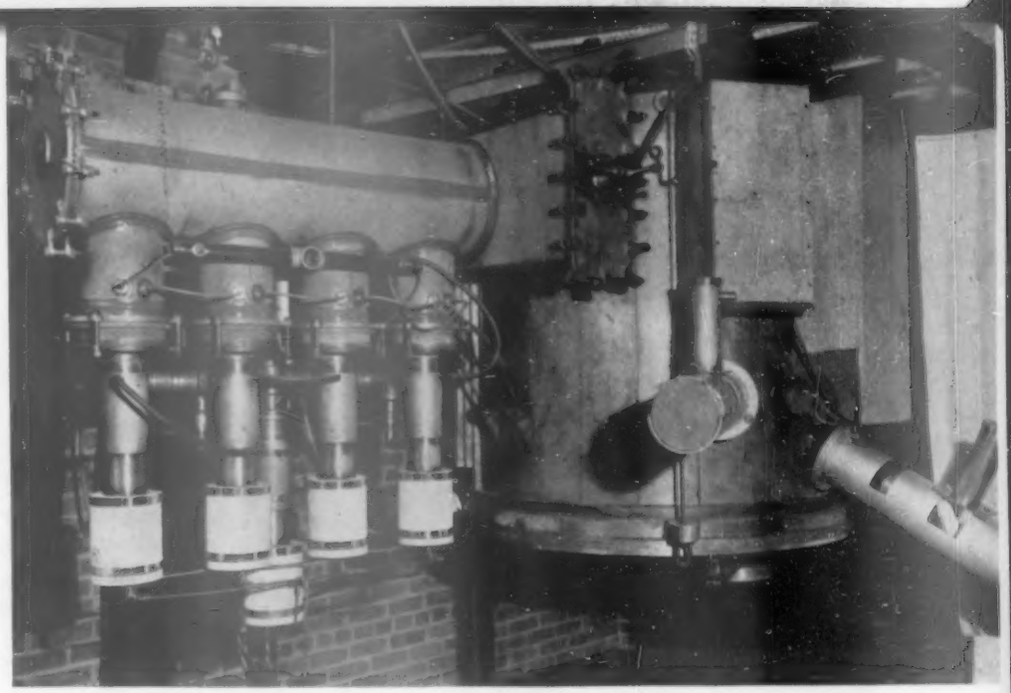
Composite Structures

Many fabricators use the mobile-structure steels in flame-cut, welded assemblies, while other manufacturers use them in the form of castings. Railroad cars are often composite structures; they utilize the mobile-structure steels both as castings and as welded assemblies, frequently, in conjunction with stainless steel. Over 2,000 light-weight railroad cars in the United States have been made at least partially of mobile-structure steels.

Much has been learned about the best methods of welding these alloys, and steel foundries have acquired great skill in casting them into sound light-weight structures. Manufacturers have also utilized these steels extensively for light-weight diesel engine frames, either as welded assemblies or as castings of comparable lightness.

The most economical attainment of the desired properties is usually se-

This United Air Lines plane has an exhaust manifold of 18-8 stainless steel.



Welded stainless steel is used on this high-voltage x-ray machine, employed for cancer treatment.

cured by a correct balancing of various alloying elements. Although it is difficult to state which is the best of the numerous analyses, it has been observed that those of this group which give optimum resistance to oxidation and corrosion almost invariably contain chromium, and that the atmospheric corrosion-resistance of those containing it is somewhat better than that of plain carbon steels. If mobile-structure steels having air-hardening tendencies are destined for fabrication by welding without subsequent heat-treatment, low carbon contents are specified.

Metallurgical advances are helping to improve the uniformity and quality of steel. Heat-treating—and its avoidance where possible—the control of grain-size and avoidance of slag inclusions are receiving particular attention.

The use of special ferro-alloys and non-ferrous scavenging, deoxidizing, and alloying additions to control grain size is now common practice. Exceptionally pure grades of calcium alloys are available for the production of steels of high purity, and ferro-alloys of columbium and titanium, and aluminum are used in various chromium steels to induce grain refinement, to eliminate air-hardening, and to improve the fabrication properties. Columbium is said to be the most effective of these alloying elements in the wrought chromium steels. In many cases, it eliminates the need for the subsequent heat-treatment of welded parts, and improves the oxidation resistance and creep strength.

Experience gained in welding the various alloy steels is now sufficient to insure successful results in practically every instance. Operators of welding equipment realize the importance of knowing the analysis of the steel which is to be welded. Only with this knowledge can they be sure to select the correct type of welding rod. The 24 per cent chromium, 12 per cent nickel rod is increasingly popular for oxy-acetylene welding many of the straight chromium steels.

Other important advances in alloy steels, which can only be mentioned briefly, are the extended use of cast steels containing up to 3 per cent chromium for wear-resistant applications; the tendency to replace rolling mill rolls of plain steel, or certain high-carbon alloy steels, with rolls of low-carbon, low-alloy steels; the growing popularity of 18-8 chromium-nickel stainless steels modified for special applications with other alloying additions; and the increased manufacture of alloy steel castings by the centrifugal method.

Stainless Steel Advances

While the automotive, chemical, textile, food and beverage, and railroad industries continue to be the major consumers of stainless steel, the proportion of the output that is devoted to "miscellaneous" uses emphasizes the broadening acceptance of stainless steel in a wide variety of fields. One of the major steel producers stated recently that 35 per cent of their stainless steel sales are classified as miscellaneous. This points to public recognition of the fact that stainless steel is endowed with a unique combination of properties — strength, rustlessness, beauty and permanence—and it shows that the fabricators of stainless steel products are now convinced that public demand for stainless steel is genuine and permanent.

The "miscellaneous" uses of stainless steel include an extremely large variety of products, ranging from pen points to X-ray machines. Considerable tonnages are also being used in aircraft, restaurant equipment, architectural trim and cutlery.

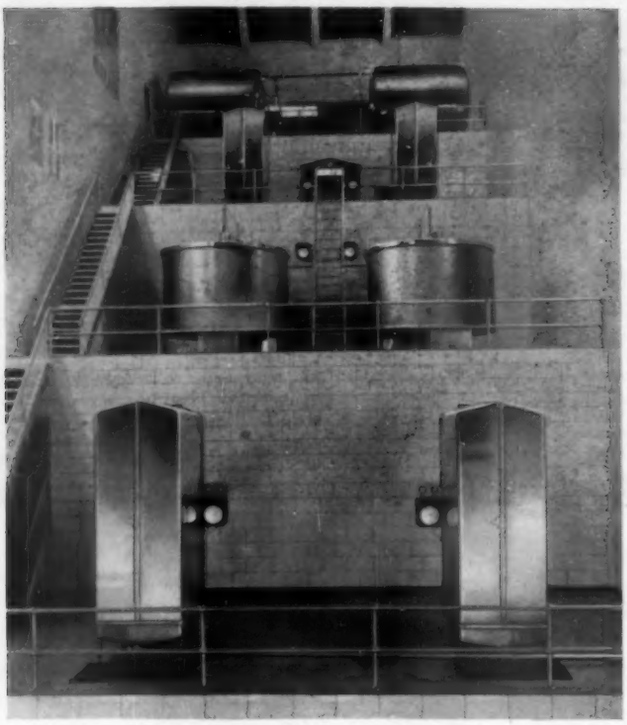
As a result, all industry is benefiting. This year fabricators are using a million dollars' worth of stainless steel in textile equipment alone, whereas, in 1930 the consumption of stainless steel for dye vats and other textile applications was practically negligible. The tonnage of stainless steel now being consumed in railroad car manufacture actually exceeds the total production of this metal in the boom days of ten years ago.

Recent developments have been made in the stainless steels to adapt them to special applications and methods of fabrication. The most popular stainless steel is of the well-known type containing 18 per cent chromium and 8 per cent nickel. This has excellent strength, toughness, and resistance to corrosion at ordinary temperatures. If it is to be welded or exposed to certain elevated temperature ranges, during extended periods of service, the addition of columbium is desired to prevent susceptibility to corrosion of the zones exposed to these temperature ranges. If the stainless steel is to be exposed to sulphuric acid, or to certain other chemicals, the addition of about 3 per cent molybdenum is desirable. For improved machinability, sulphur or selenium is added.

T. R. LICHTENWALTER*

★ At the recent I. A. A. convention in Birmingham, Ala., an excellent paper was presented on stainless steel welding. T. R. Lichtenwalter discussed the straight chromium and austenitic types in relation to their weldability. The straight chromium steels are brittle as welded, while the austenitic types (18-8) are very ductile in the as-welded condition. Peening the weld and annealing tend to improve the ductility. When used for nitric acid equipment all welds in stainless steel must be annealed to obtain full corrosion resistance. Mr. Lichtenwalter stressed the need for controlling warpage, because of lower heat conductivity and higher thermal expansion. He included suggestions on proper han-

*Welding Engineer, Republic Steel Corp., Massillon, Ohio.



Welded stainless steel equipment for milk processing assures finishes of sanitary smoothness.

dling of welding rod in the oxy-acetylene process. What follows is taken from Mr. Lichtenwalter's technical paper:

In the past ten years the steel industry has perfected new alloys for those industries demanding materials to withstand high temperatures and extreme corrosive conditions. These have been met to a great extent by the alloys containing chromium or chromium and nickel. The temperature or corrosive condition to be met governs the content of these elements, and to meet certain conditions other elements, such as molybdenum, titanium, columbium and silicon are added.

The high chromium and chromium-nickel alloys of iron are generally known as stainless irons or steels. The stainless alloys can be classed in two groups; first, the straight chromiums, ranging from 11 per cent upwards, which are magnetic, and the chrome-nickel types ranging from 17 per cent chromium and 7 per cent nickel upwards, which are non-magnetic in the annealed state. The stainless alloys are highly resistant to most acids which are oxidizing in their nature, but reducing acids such as sulphuric and hydrochloric will attack them readily. They are resistant to oxidation and scaling at high temperatures and also retain their high physical properties at elevated temperatures.

For these reasons they are meeting increased demand each year in the chemical, oil, textile, automotive, food, dairy and many other industries requiring a material with unusual corrosion and heat-resisting qualities. Stainless steels are supplied in plates, sheets, bars, strip, tubing, bolts, nuts, rivets, wire and many other shapes obtainable in common steel. They can also be rolled, drawn or formed into almost any shape or part as required by the fabricator, if proper procedures are followed.

If it were not possible to weld the stainless alloys, their present wide and diversified use would not be possible. Both the straight chromium and the austenitic chrome-nickel types are weldable. The straight chromium types are brittle in the as-welded condition. However, the austenitic types are very ductile in the as-welded condition.

Straight Chromium Steels

In considering the oxy-acetylene process of welding, the straight chromium steels will be discussed first. Due to the low ductility in the as-welded condition, we must first look to the design of the part to be fabricated and lay out the joints where they will be subjected to the least stress. It may also be well to mention that this is a good procedure to follow on any job being designed for welded fabrication. Many of us in the past have been shown blue prints of a part which the designer could conceive no way to assemble. Apparently he just penciled an arrow with the note "weld" and, much to everybody's surprise, the assembly would be made. Of course, we cannot mention what the operator said and possibly some of the contortions he went through would have made a frog violently jealous.

The physical properties of the straight chromium alloys are fairly comparable and the following is typical of a 16-18 per cent chromium containing .12 maximum carbon in the annealed condition:

Tensile Strength .....75,000 psi.
Elastic Limit.....50,000 psi.
Elongation in 2 in...25.0%
Reduction of Area..60.0%
Hardness of Brinell..160
Thermal
Conductivity .....60% that of mild steel
Coefficient of
Expansion .....0000096—0—100 deg. C.

From this it may be understood that both the thermal conductivity and the coefficient of expansion are somewhat less than steel, and the job can be laid out using almost the same procedure as for steel. The lower heat conductivity will be found to give some trouble due to the warpage in the lighter gauges, but this can be taken care of by proper design of joints and the use of welding fixtures.

Use 18-8 Welding Rod

The writer most generally spaces the joints about the thickness of the gauge and uses 18-8 chrome-nickel welding rod for tacking. The frequency of these tack welds depends on the length and type of welded joint to be made, and in some assemblies are as close as every inch. After tacking, the back side of the joints are fluxed and the weld finished by using the same type of filler rod as the sheet or assembly being made. If it is possible to peen the weld while still hot, the ductility

Welded beer barrel with stainless liner.

of the weld joint can be improved, and if followed by an anneal, much more ductility can be attained. Annealing the fabricated part is not always feasible, but will increase the ductility especially the alloys under 14 per cent chromium.

The straight chromium types being generally used for elevated temperatures and for corrosive conditions of the lesser nature very seldom require annealing after welding except when used for nitric acid. If the equipment is to be used for nitric acid, the article must be annealed before putting into service.

Chrome-Nickel Types

We will next consider the welding of the austenitic chrome-nickel types which are most readily welded and possess great ductility in the as-welded state. The physical properties again are comparable to the 18 chrome-8 nickel type as follows:

Tensile Strength .....85,000 psi.
Elastic Limit .....40,000 psi.
Elongation in 2 in...60%
Reduction of Area..65%
Hardness Brinell.....140
Thermal
Conductivity .....40% that of mild steel
Coefficient of
Expansion .....000016—0—100 deg. C.

Here you will note we have considerably lower heat conductivity and a higher coefficient of expansion than in mild steel. These two characteristics are poison to the operator who is not familiar with this type of alloy, but it is surprising to know how well he can control warpage if he understands the game and is willing. The design of the joint is a deciding factor, and where it is not possible to design to control warpage, fixtures are a necessity. Here again the writer generally spaces plates the thickness of the gauge and uses numerous tacks. This is followed by fluxing the back side and proceeding with the weld.

Arc-welded annealing box of Enduro stainless (25-12) steel.

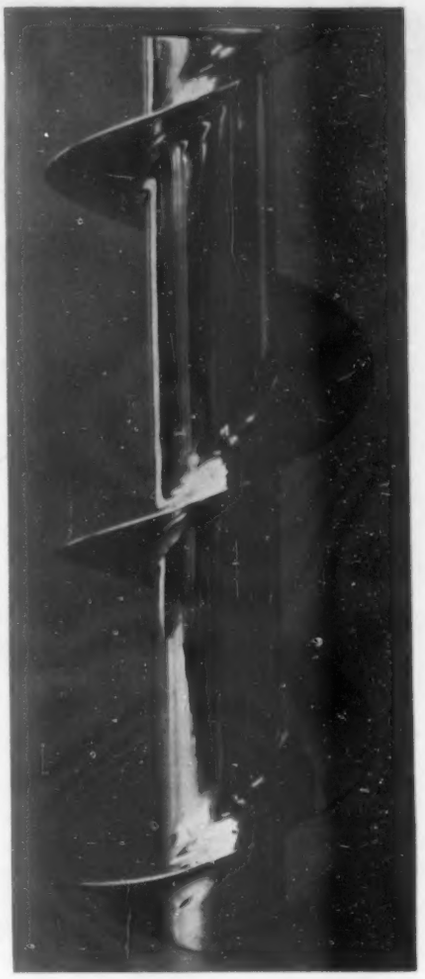
In some instances, where only a short weld is to be made, say up to 6 in., the job is spaced the thickness of the gauge at the start, and a little over 1/4 in. per foot spacing is used to take care of expansion. It is well to tack the end first, start the weld at the open end, then proceed in the direction of the tack. If this is not done, you may find yourself looking at a space twice as wide as you had originally allowed for or just the reverse. Chrome nickel types of stainless, due to their physical properties must have the weld laid down in a uniform manner. The speed should not be too fast, as this will generally close the gap, whereas too slow a speed opens it. The amount of heat is also a governing factor, excessive heat tending to increase the gap and deposit an excess of the required amount of weld metal.

Flame Adjustment

The actual welding operations for both types of stainless are practically the same. Equipment should be in good condition, the regulators should maintain an even flow of gases and the blowpipe should be capable of delivering a uniform flame. As stainless materials melt at a lower temperature than mild steel and also have lower conductivity, a welding tip with an orifice one to two sizes smaller should be selected rather than the one used for the same thickness of mild steel. The flame should be adjusted so as to show a slight excess of acetylene, 1/32 to 1/16 in. of acetylene feathers will be found to give best results. This adjustment will not carburize weld metal excessively and will maintain a reducing atmosphere over the molten pool, preventing the oxidation of the chromium.

As previously mentioned, the back side is fluxed, using specially prepared flux. This flux, as the weld proceeds, forms an envelope preventing oxidation of chromium at this point, thus enabling the operator to obtain full and uniform penetration of the weld metal throughout the joint.

Bare welding rods are best suited for oxy-acetylene welding and should be kept out of the welding cone of the flame and brought in for metal addition only when needed, but still keeping it protected in reducing atmosphere of flame envelope. This will protect the end of the rod from being oxidized. Some operators remove the



Spiral flange welded to tube and highly polished (Enduro 18-8-S).

end of the welding rod completely out of the envelope. This can be done by those operators who understand the peculiarities of molten stainless, by making sure the end of rod is not molten before removing from flame. The weld should proceed with very little puddling, the tip of the welding cone almost touching the molten pool. The joint can be knit together by a back and forth motion. However, the round and round motion so often used for welding mild steel will give a spongy weld, which often will not be noticed until after the fabricated article is in service.

Most operators' difficulties come at the end of a weld due to a deep crater or hole all the way through the seam. They also have the same trouble when patching or spotting leaks. This can be readily overcome at the end of a seam by running out on the end of the welding rod. The best way to finish a weld or a spot is to raise the blowpipe slowly away from the molten pool, allowing it to solidify while still protected by the reducing flame.

Portable Rail-Welding Unit for London Subways

★ The first portable rail-welding plant to be used in the United Kingdom has recently been placed in service by the London Passenger Transport Board. It has been designed for the welding of both the running and conductor rails of the Board's subway system, such welded rail reducing the noise in the underground section of the system. This welding unit will later be assisted by a traveling grinding car, and when the complete service is in operation, it is estimated that the amount of noise in the London subways will be reduced by 60 per cent.

The welding is not done in track position, the plant being portable solely with the idea of moving it readily from job to job. The rails are supplied in standard lengths of 60 ft. and are welded at definite field locations into lengths up to 300 ft. for the running rails and 240 ft. for the conductor rails. They are then transported, as required, in these continuous lengths for laying. These figures refer to the rails in the tunnels, in which the temperature is approximately constant.

For the sections of the system out in the open it is proposed to restrict the lengths of the running rails to 240 ft., and of the conductor rails to 120 ft. The running rails weigh 95 lb. per linear yd., and the conductor rails up to 150 lb. per linear yd. The plant is designed to handle running rails having a cross-sectional area of 12 sq. in., and conductors with an area up to 15 sq. in.

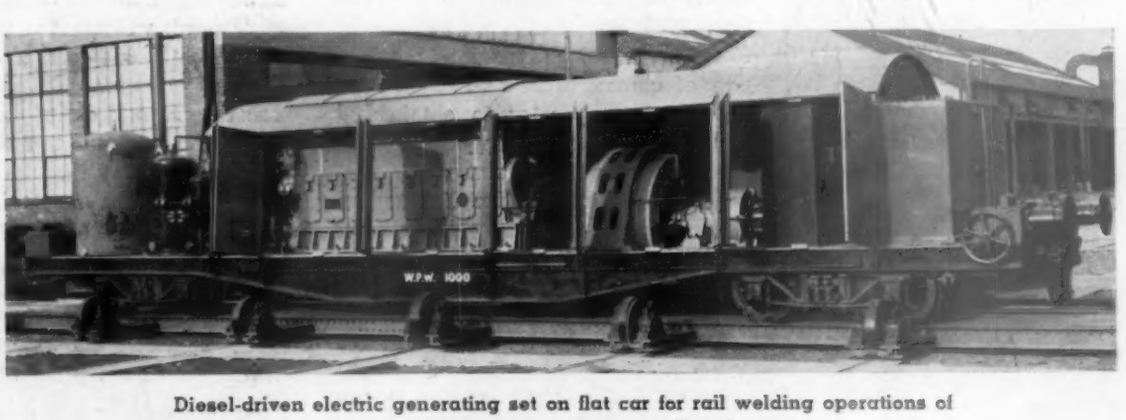
The plant consists of three independent units—a vehicle carrying a diesel-driven generating set and one carrying the automatic butt-flash welder and a post-heating apparatus for normalizing the joint after welding. The generating set comprises an 8-cylinder diesel engine developing 400 h.p. at 800 r.p.m., and a 300-kva. alternator giving 750 amp. at 400 volts. The control panel is located near the alternator with an operating compartment between it and the fuel tank. The air-compressing equipment comprises a motor-driven compressor, receivers, etc., and serves such auxiliaries as the mechanical parts of the post-heater and the grinding and chipping portable tools.

The automatic flash welder is located in the center of the welding car, and on one side of it is an air receiver, and on the other a motor-driven compressor for actuating the welder. The welding plant (made by A. I. Electric Welding Appliance Co.) comprises the automatic flash welder and the post-heater, both rated at 300 kva. Tests made with this welding plant show that rails having a carbon content of 0.7 per cent, a chromium content of 0.6 per cent, or rails which have been "sorbitically treated," can be dealt with satisfactorily.

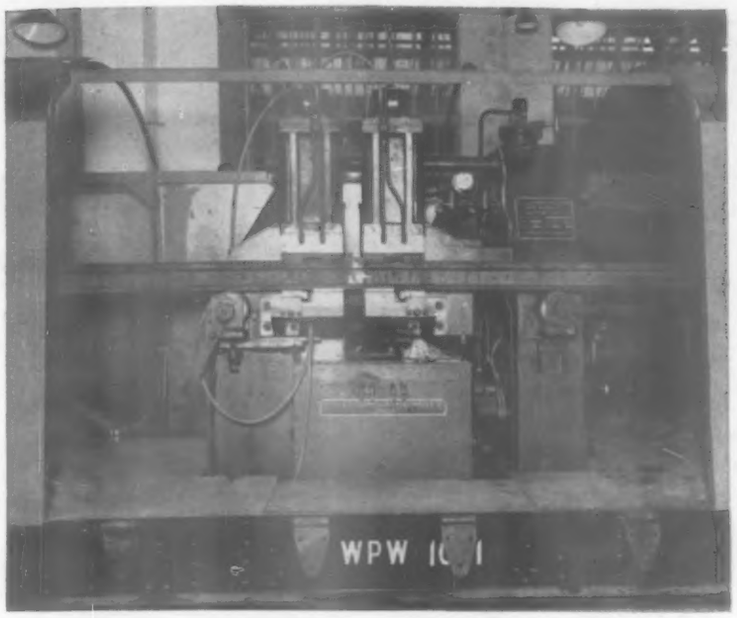
The machine is illustrated with running rails of 95-lb. section in position for welding, the rails being aligned and clamped at points adjacent to the butt weld. The left-hand welding head is stationary, but the right-hand head is mounted on slides and is capable of longitudinal movement along with the length of rail it carries. The movement of the rail, when welded, is from right to left; that is, the continuous portion passes through the end of the car at the left and the new lengths to be welded are passed through the right-hand end. Both the short and continuous lengths of rail are supported on rollers carried on trucks suitably arranged to give the correct height to the rail as it passes through the welder.

The actual welding operation will now be described. The clamping is affected by a pneumatically-operated mechanism which exerts a heavy pressure. Pushing a button then starts the welding process, no further attention being required from the operator until the weld is completed. The first part of the process is the pre-heating of the weld, which is affected by the reciprocation of the right-hand head with its rail. The reciprocating movement controls the welding current flow, heat being given to the rail partly by conduction from an arc and partly by the heat generated by the resistance of the steel to the heavy current. The reciprocating movement is maintained for approximately two minutes, at the end of which time the metal is in the correct condition for the change-over to flash welding. This change-over is automatic, and the resultant arc, which is maintained for about 10 sec., generates a temperature of about 3,500 deg. C. The maximum current flow is 45,000 amp.

Another automatic change results in the current being cut off and the right-hand length of rail being forced up to



Diesel-driven electric generating set on flat car for rail welding operations of London Passenger Transport Board.



Close-up of electric butt-flash welder with rails in position ready for welding operation.

the left-hand rail with a forging pressure of 27 tons. The complete welding operation is thus carried out in less than three minutes. The welding pressure is applied by a lever, the pressure being derived from a pneumatically-operated cylinder, the piston of which is coupled to the end of the lever, and transmitted to the welding head at a point on the lever approximately in line with the rail. The jaws are removable so that they can be readily changed for the welding of the different rails, the running rail being of the double-headed type, while the conductor rail is flat-bottomed.

After the weld is completed the rails are moved to the left until the joint is clear of the welder and is located at the chipping station. here the fin is chipped off while still hot. Further movement brings the joint into the post-heater. This has two heads quite similar to those of the welder, the clamping being pneumatically effected. The heating current is maintained until a temperature of 850 deg. C. has been reached, when it is automatically cut off, through the agency of an optical pyrometer control. The heating heads, however, differ from those of the welder, in that they are provided with a transverse movement, so that they can be withdrawn sufficiently to allow the rail to be lifted out when necessary, without having to be moved laterally. Automatic regulation of the heating, of course, ensures uniformity of heat treatment for all parts of the continuous rail. The rail is then passed along for the final dressing and grinding of the joints, a portable pneumatically driven wheel being used. The finished rails are then either transported to special cars for delivery to location or stocked at an appropriate depot.

The complete operation of welding, post-heating, and dressing, with the attendant handling, requires about 10 min., so that, with running rails, six welded joints can be made per hour.

New Welding Techniqiue to Control Stress Problem

★ The Public Service Electric & Gas Co. has let a contract, which work is now in progress, to the United Engineers & Constructors for the improvement of power generating facilities at the Essex Plant. A great deal of high pressure piping is embodied in this work. A new method of electric welding, which includes preheating and normalizing the piping welds, is being used.

While preheating for certain classes of work has been known for years to be a way of obtaining better physical properties of the weld, its application by this method is believed to be new. Both thermit and gas welding embody, in nearly all of their procedures, some means of raising the temperature of the metal before fusion welding is started. Electric welding has sort of prided itself on its ability to weld mild steel without such previous heating, but the introduction of alloys, especially the high strength alloys used in modern high pressure piping, requires certain definite temperatures at which the weld should begin and end. Proper procedure also requires raising of the temperature to the desired normalizing or stress-relieving point.

This is being accomplished on the Public Service job with specially arranged coils of wire on either side of the weld, through which coils 60-cycle a-c current is fed at predetermined amperages according to the size of the pipe. The heat induced by these coils is obtained at a lesser cost than by the electric arc. Of course, the preheat reduces, by that much, the amount required from the arc source. The pipe is heated by hysteresis and eddy current losses; first to the preheating temperature and after the weld is made to the higher normalizing temperature by the same coil arrangement. The temperature is held there as long as required to obtain the best grain structure, according to known heat treating developments.

These temperatures are under pyrometer control and by means of taps and a switching arrangement can be held at any level and for as long as desired. There is an inherent safety factor at the high temperature due to the loss of magnetism in the pipe or other material in the electromagnetic field. For lower temperatures an accurate table has been worked out. In addition, visual and recording pyrometer readings are used together with a record of the current and voltage.

This system not only allows welding to proceed without change of location or connections to the heating coils, but also allows caulking and peening and any other necessary mechanical work to be accomplished without hin-

Test specimen of welded pipe being fixed up for purpose of qualifying the new process.

Heating coils applied to pipe being weld fabricated by the "gradient welding" process.

drance. Re-heating, if desired, is feasible.

It is stated that the solution by this system of all problems of heating in connection with alloy steel pipe welding appears to be complete. The welds produced have been pronounced to be equal, if not better than any produced by other systems. The advantages of this system seemed to be so apparent that the Electric Arc Cutting & Welding Co., Newark, N. J., has obtained the rights to promote the use of the process.*

This system of "gradient welding," so named by its sponsors, the Electric Arc Cutting & Welding Co., is applicable not only to piping, boiler, pressure, and fired vessels, but to any important structure. In this system there is said to be no stress or strain. The metal is preheated to the best temperature for welding and is never allowed to cool, even at noon hour, night, or week-ends. The temperature is held constantly and when the job is finished it is raised to the point for best grain growth and then backed down slowly to the ambient (initial) temperature. With this gradient system the field connections can also be made equal to the pressure vessel. Important other welding, such as building and bridge connections, can be done without disquieting fears as to the factor of safety.

This preheating and normalizing is accomplished by ordinary power current from a heating or welding transformer by the hysteresis losses in the parent metal. Temperatures can be controlled as desired and as smooth a gradient as desired for as long a time as needed can be obtained with little expenditure of electric energy. It is claimed to be much cheaper than any other method.

This gradient welding, starting from an elevated temperature of 400 deg. plus, leads the metal upward by easy steps and downward in the same manner. It is said that no stresses are ever present. It is further suggested that the term "stress relief" should be dropped as no such thing can occur with this system. Previous welding procedure, it is stated, has been to allow the stresses to appear and then attempt to relieve them. Furthermore, the stresses are not all in the weld, but develop from the very steep gradient from the weld to and through the rest of the structure.

The Smith-Dolan method (here described) smooths out this gradient imperceptibly and automatically. With ordinary procedure, the building up of a steep gradient causes undesirable changes in grain structure and sets up stresses in the parent metal. This is why big vessels have to be placed in an oven, before the parent metal cracks. With this new method the changes, upward and downward, are imperceptibly gradual.

* Patents are pending on this method and The Electric Arc Cutting & Welding Co. is exclusive licensee.

Maybe the Liberty Bell Will Be Next

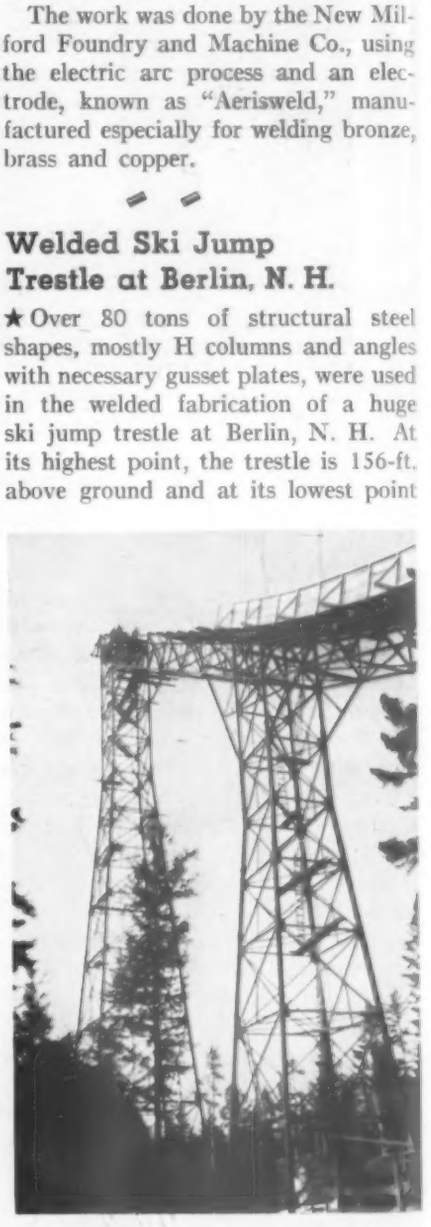
★ A practical method of repairing cracked church bells was demonstrated recently at New Milford, Conn., when a crack developed in a bell 116 years old in a small church. Following repairs to the 600 lb. congregation caller, it was said to have perfect tone. Not only was the rector, the vestry and the congregation extremely pleased with the results, but they were pleasantly surprised at the low cost of the repairs. The entire work of removing the bell, repairing the crack and rehanging cost only $92.50. To replace the bell by recasting it would have cost $350 without considering the labor involved.

The work was done by the New Milford Foundry and Machine Co., using the electric arc process and an electrode, known as "Aerisweld," manufactured especially for welding bronze, brass and copper.

Bronze welded repair to a cracked church bell saved $257.50.

Welded Ski Jump Trestle at Berlin, N. H.

★ Over 80 tons of structural steel shapes, mostly H columns and angles with necessary gusset plates, were used in the welded fabrication of a huge ski jump trestle at Berlin, N. H. At its highest point, the trestle is 156-ft. above ground and at its lowest point (the "takeoff") it is about 23-ft. above ground. The overall length of the structure is roughly 300-ft. Of course, the steel trestle is only the upper portion of the ski jump, the landing area below being a natural slope. The claim is made that this welded trestle is the tallest ski jump in the world. Erection, including welding, was carried out during extremely cold weather, the temperature at times dropping down as low as 20 deg. below zero.



Looking at the tallest tower of the welded ski jump trestle.

The towers were laid out properly in the shop, but with only enough bolts to hold the structure together until the welders could come into action and give the joints the proper strength.

This of course necessitated carrying up the towers one or two bays at a time and then letting the welders do their part. The erection crew worked back and forth from one tower to another and the welders did likewise. The structure consists of four towers of varying heights to give the proper slope and curvature to the runway. Between these towers heavy trusses were erected in pairs. A total of three pairs of trusses, with necessary cross bracing, were used.

In spite of cold weather, there was little trouble with welding, even though the temperature at times went down to 20 deg. below zero. Welders worked in relays at each position. That is, one man would be down in a hut below getting warm, while another man would put in 10 to 15 minutes of welding.

Even though it is usually supposed that shrinkage at welds will throw members out of line, it is reported that when all four towers were completed the alignment was out less than an inch. This was noted on but one tower, where there had been a shop error and was easily rectified on the job so that the trusses fitted perfectly. The upper end of the highest truss had to be raised nearly 160-ft. in one lift to get it into position, but very little difficulty was encountered, it is claimed.

Car Bumper and Spring Welding

★ While most welders are familiar with car bumper repairing and the general principles herein given are common knowledge among most repair men, a few may gain a helpful idea or two from these precautionary suggestions.

During the welding of a bumper arm or a spring, the metal at the welded portion is melted. The heat from this melted metal radiates outward into the colder portion of the bar. In the case of a spring, and often in the case of a bumper arm, the metal was originally heat treated at the factory. There is therefore a region near the weld, where the metal has been heated enough to change the characteristics originally given it by the heat treatment at the factory. In the weld zone new metal has been added, and usually the bar has been reinforced, if a first-class job has been done. Therefore, in a limited area, there occurs a place where the metal is weaker than at any other point. A sudden blow or severe strain often causes the bumper to break at this point.

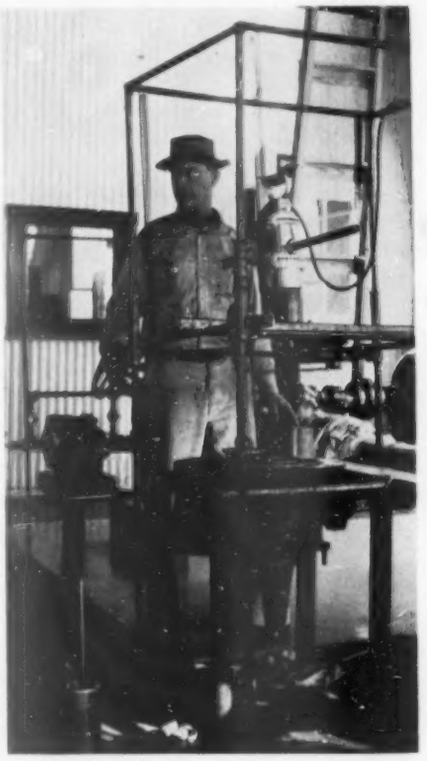
If the torch is used to heat the spring to a red heat for a couple of inches or so on each side of the weld, and then allowed to cool slowly, this zone will be spread out over a larger area. While the steel may not have the strength and resilience given it by the original heat treatment, it will at least be stronger and tough enough to withstand considerably more strain, than if merely welded and this extra precaution not taken. A little time thus expended may mean the difference between a satisfactory and an unsatisfactory job, and prevent many jobs from being done over.

Streamlined Street Flushers Arc Welded

★ The trend toward more attention to beauty in design, whether it's a streamlined street flusher, like the one here pictured, or a de luxe pleasure car, frequently calls for more welding and more steel as well. The street flusher is one of 75 of this design recently purchased from the Municipal Supply Company, South Bend, Ind., by the New York City Sanitation Dept. In keeping with modern trends the tank and pumping equipment is shielded by streamlined side skirting. All-welded construction made it a simple matter to obtain strong tight joints in the tank construction, which embodied a number of compound curves. Spot welding was utilized in integrating the skirting with the tank, as well as in securing both the tank and the skirting to the frame. The tanks were made by The Heil Co., Milwaukee, Wis., and the steel sheets of which it is fabricated were produced by the Bethlehem Steel Co.

All-Welded Frame For Valve Grinder

★ Harnessing a portable electric drill to the job of valve grinding in a large crude oil pumping station necessitated the fabrication of a steel frame strong enough to support the cylinder head. This frame was equipped with supports upon which the skeleton platform carrying the electric drill could be adjusted vertically and laterally to bring the power directly above the valve to be rotated.



One man operates portable valve grinder during spare time available while on duty at the station.

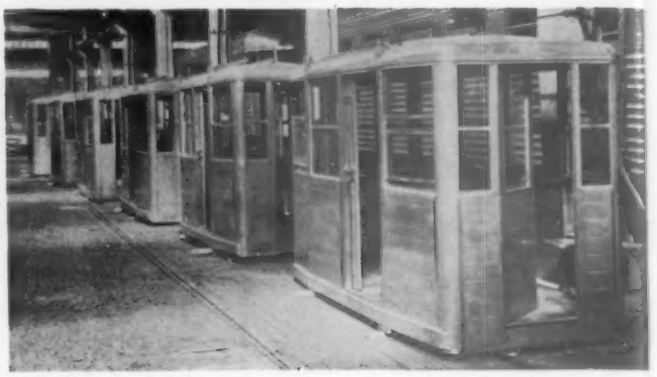
All-welded construction was used in this streamlined street flusher.

Detail of corner construction of valve grinder frame. Pipe sections provide a light, but rigidly braced frame work.

A rectangular frame was built up from 7/8 in. sucker-rod stock, each of the uprights being fitted with a slide or slip of one-inch pipe 8 in. long. Centered in the base was a raised frame, open on one side, of sufficient width to admit the cylinder head, and high enough so that the (inverted) valve stems would clear the floor.

Two pairs of one-inch pipe slides were connected with cross members of the same steel as used for the frame, and across these and near the welds, were welded two additional lengths of one-inch pipe, in such position that a rod could slide through each pair and form the basis for the frame which carries the drill. Thus mounted on the vertical frame members, the height of the power platform could be adjusted as desired, four coiled springs carrying the excess weight. While the two sliding horizontal rods allowed the rotating mechanism to be spotted laterally as desired, the sliding of the cylinder head in its frame permitted bringing the desired valve under the rotating yoke.

This all-welded frame enabled a cylinder head to be serviced in one-third the time required with the former hand-grinding method. The new valve grinding fixture so simplified the work that all valve-grinding save for major overhauls can be done in an oiler's spare time.



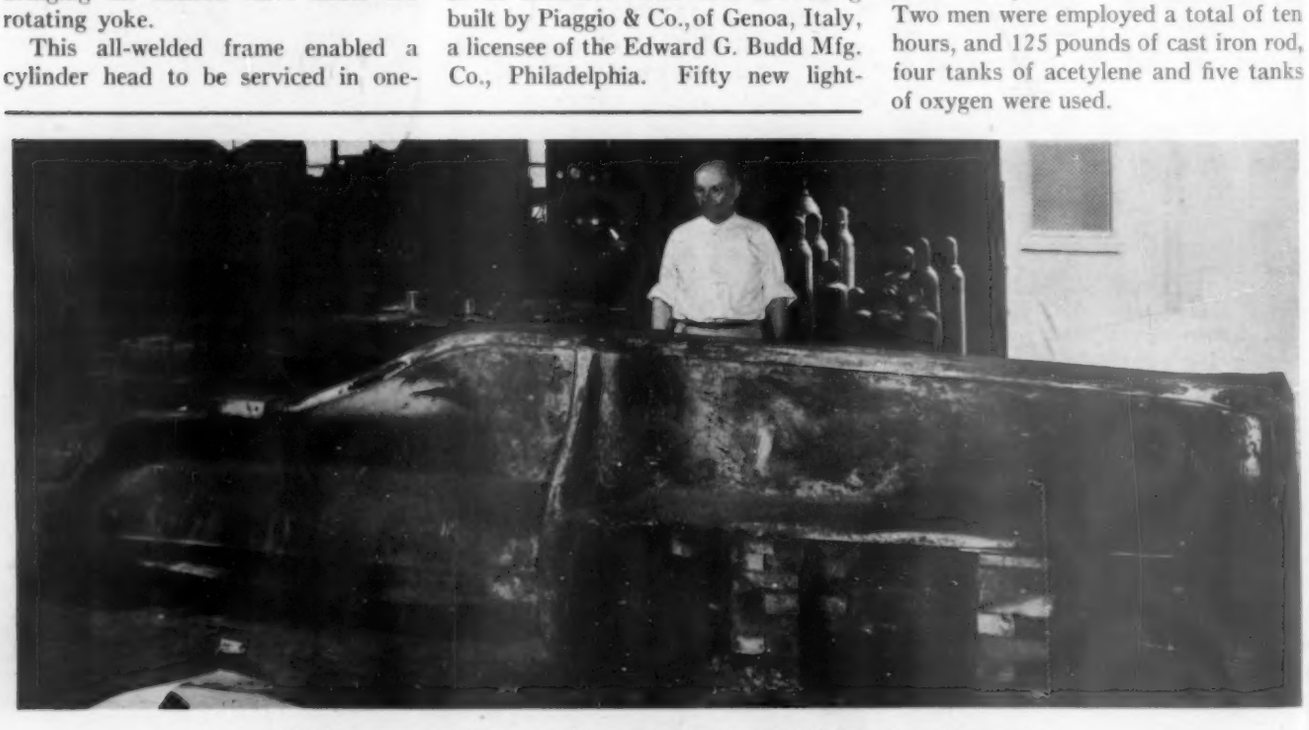
Stainless steel cable cars weigh 56 per cent less than type previously used.

Weight Reduced for Alpine Cable Cars

★ The 16-passenger stainless steel cable cars shown above, part of a 30-car order, weigh 56 per cent less than the type formerly used in the Italian Alps. This newest type of car weighs but 660 lbs. and will be used to haul skiers and mountain climbing tourists. An unusual weight-saving feature, aside from use of light weight construction and the "Shotweld" method of fabrication, is the employment of cellophane instead of glass in the large windows. It is as serviceable in winter as in summer. The cars are being built by Piaggio & Co., of Genoa, Italy, a licensee of the Edward G. Budd Mfg. Co., Philadelphia. Fifty new lightweight stainless steel railway cars, two of which may be seen in the background, are also being constructed by the Italian company.

Seven-Ton Engine-Bed Casting Repaired

★ A Corliss engine bed, weighing in the neighborhood of seven tons, was repaired recently with the oxy-acetylene torch at the shop of the Friede Welding & Boiler Repair Co., 3127 Pine Street, St. Louis, Mo. The casting had been incapacitated by a fracture across its middle. John E. Friede, head of the welding concern, says a T-iron type weld was made, corresponding with the cross-sectional shape of the casting. The base of this T weld was 8 in. wide by 4 in. thick, the top measured 30 in. by 3½ in., and from base to top the T measured 28 in. Two men were employed a total of ten hours, and 125 pounds of cast iron rod, four tanks of acetylene and five tanks of oxygen were used.

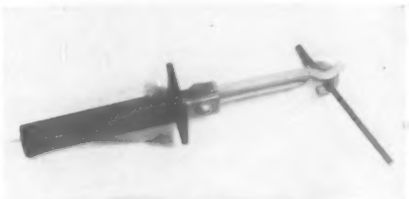


Welding repair of 7-ton Corliss engine bed used 125 lbs. of cast-iron rod.

New Equipment Developments

Novel Electrode Holder Has Replaceable Jaws

★ A novel and effective electrode holder has been developed by a California firm. It is made in three sizes to take rods from 1/16 in to ⅜ in. diameter. A fibre handle, uniform for all sizes, is fitted with replaceable jaws. The design of the jaws permits quick insertion of rods in any position. Freedom from levers, springs and hinges makes it convenient to work in limited space.



Novel electrode holder has replaceable jaws.

The handle is air-cooled and has a fibre heat-shield that protects the operator and prevents short circuit if the tool is laid down. These holders are well balanced and light in weight. The largest size weighs only 22 oz. Combination cable connection permits either soldering or clamping, or both. Replaceable jaws are made of heat-treated spring steel, with serrated faces to prevent electrodes from slipping. Economy results because the handles can be used constantly and are not discarded when the electrodes need replacing. Delong-Cramer Co., Southgate, Calif., the manufacturer, has literature available describing this new product.

Polarity Control for Welding Generators

★ With the increasing use of special welding electrodes, it has become necessary to equip all welding sets with some sort of polarity-reversing switch, to facilitate instant change of the direction of current flow in the arc. On separately-excited sets this switch is generally arranged to reverse the separately-excited field, but on self-excited generators it must usually be a large knife switch in the output circuit of the generator. This switch must carry the entire welding current and is therefore necessarily large.

A new polarity control scheme designed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., energizes the field of the welder from a separate source, comprising a small transformer and Rectox unit. This unit excites the field just strongly enough to control the residual magnetism and consumes only 25 to 100 watts. This scheme not only eliminates the heavy-current reversing switch but also guarantees against reversal of polarity.

Dustfoe Respirator

★ The Dustfoe Respirator, weighing less than 3¼ oz., providing full protection with utmost comfort under the most severe working conditions, has just been placed on the market by the Mine Safety Appliance Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa.

Dustfoe Respirator

The Dustfoe Respirator allows full vision in any direction, does not interfere with the wearing of goggles, spectacles, welding helmets or head-coverings of any kind and, it is claimed, may be worn for long working periods with entire comfort. All metal parts are made of aluminum, are quickly replaced, and may be sterilized at any time, including the easy fitting, soft rubber face-cushion. The new two-element Dustfoe filter will eliminate dust particles as small as one micron (1/25,000 in.) in size with highest efficiency and very low breathing resistance. Replacement of filters is simple and requires but a few seconds. Low-cost of cellulose filters assures economical maintenance.

A complete description and illustration of this new respirator may be found in bulletin CM-1, copy of which can be had by writing the manufacturer direct.

New Type of Metal Spray Gun

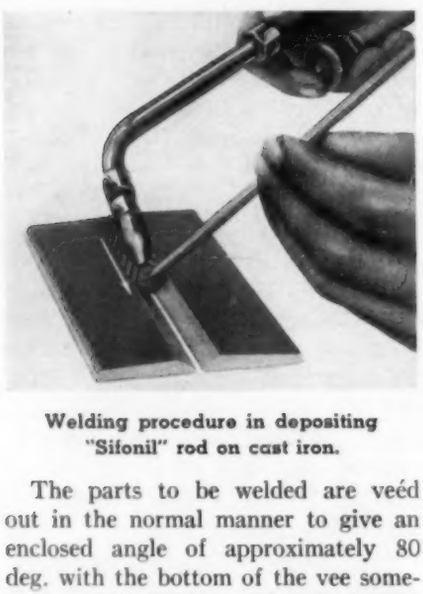
★ Welders and metal finishers are discovering new and important uses for protective metal coatings. The development of the Stevens metal spray gun is stated to make the application of metal coatings more economical and more efficient. Manufactured by Stevens Metal Spraying, Inc., 83 Shipley St., San Francisco, Calif., this new gun is synchronized so that the feed is automatic. One of the exclusive features is a two-speed gear shift which makes possible the use of both hard and soft metals without complicated adjustments. The Stevens gun has a capacity of 8 lbs. of aluminum per hour, or 10 lbs. of steel, 18 lbs. of copper, or 30 lbs. of zinc.

Tanks, vats, girders can be metal coated against corrosion. Food machinery, coils, and glass-lined tanks can be tin coated. Full details of the gun and specifications for spraying all metals and surfaces can be obtained from the manufacturer.

Stevens Model 02-3 spray gun.

Low-Temperature Rod for Cast Iron

★ A new welding rod, "Sifonil", is being introduced in England for the low-temperature welding of cast iron. Suffolk Iron Foundry (1920) Ltd., Stowmarket, England, is the manufacturer. The welding technique is similar to brazing, or bronze welding, but the finished weld has the same color as the parent casting. A major advantage is the reduction in amount of preheating required and with "Sifonil" rod the heat is more localized.



Welding procedure in depositing "Sifonil" rod on cast iron.

The parts to be welded are veéd out in the normal manner to give an enclosed angle of approximately 80 deg. with the bottom of the vee somewhat rounded. The vee'd and adjacent surfaces are then smeared with Sifonil paste flux and the rod is similarly coated with flux before welding. The casting is then preheated all over to a black-red temperature. This can often be achieved with the blowpipe itself or by coal gas burners. When the fracture to be welded is in such a place that expansion troubles will not ensue, only local pre-heating is necessary.

The sides of the vee, where it is desired to begin the weld, are next brought to a bright red using a strictly neutral flame and a blowpipe tip one size smaller than that used for the ordinary method of welding material of similar section. The end of the fluxed Sifonil rod is then brought into the flame and a drop melted off and allowed to fall on one side of the vee. If the parent metal is at the correct temperature this drop spreads out over the surface of the parent metal, melts a thin film of it like warm water poured on ice, and fuses perfectly with the parent metal. More drops from the filler rod are then added and the weld proceeds, in a leftward manner, positioning the rod and blowpipe as shown.

The weld is usually built up to the required height as it progresses. The rod is melted off almost continuously. The welding proceeds very rapidly, the blowpipe being kept on the move from side to side, behind the rod to preheat the surfaces in advance of the run to the correct temperature, and to allow the running forward of the deposited metal. The finished weld is allowed to cool slowly, after which little dressing is necessary.

By the above method a machinable weld can be executed on cast iron, which is claimed to be the equal of, and often superior to, welds made by the older method, as regards mechanical strength and freedom from slag inclusions, blowholes, etc. It is said that welding can be done at a greater speed than ever before and with considerable economy in gas and filler rod consumption. The method is applicable to all types of cast iron repairs, resurfacing, the filling in of worn places and blowholes. With slight modifications of the process, the same rod can be used for the surfacing of steel and the welding of malleable iron.

Hampton Model D A-C. Arc Welder

★ Hampton Electric Tool Co., 700 Walnut St., Edgewood, Pittsburgh, Pa., has announced the Model 'D' a-c. arc welder as an addition to its line. This machine is compact in design and made to operate on either 110 or 220-volt a-c. circuits. One of the features of this welder is its specially designed one-point control that makes possible the accurate determination of current for any welding job. This control has a plainly numbered dial for either 110 or 220 volts, which indicates the current selected.

It eliminates the use of jacks or tools when a change of welding current is desired and has a range of from 20 to 90 amp. on 110 volts and from 30 to 125 amp. on 220 volts—these ranges of current being for continuous service 24 hours a day. It can be operated at 270 amp. for intermittent service where a heavy welding job has to be done. The machine will handle welding rods from 1/16 to ¼ in.

Model D Hampton Arc Welder

Transformers in the Hampton Model 'D' welder are rigidly mounted and braced so that the unit is substantial and practically noiseless. The coils are made of wire having ample capacity, properly impregnated and baked. The chassis is made of silicon steel and strongly reinforced. The current is stabilized in such a way as to permit faster and easier welding with notably less spatter loss it is claimed. The positive current stabilizer makes it possible to strike an arc immediately and to insure continuous uninterrupted operation.

This welder is normally fused with a 30-amp. cartridge fuse, assuring ample protection with a wide margin of safety when connected to any regular 110 or 220-volt a-c. circuit. The weight of the unit complete is 190 lbs. It is mounted in a container of welded steel frame construction and covered with heavy gauge steel. It is supported by heavy ball bearing rollers which make it easy to shift the unit to a point where the work can most conveniently be done.

New Air Line Freeze Preventative

★ An additional and improved system of air line and tool freeze preventative known as "Frosto" is being marketed by the Sullivan Machinery Co. to supplement Tanner Gas which has proven successful for construction, industrial and mining operations. "Frosto" has been developed particularly for industrial applications and wherever electric current is available. In opera-

tion, the "Frosto" is vaporized in a vaporizer and is fed into the compressed air line near the compressor as fast as necessary to prevent freezing of water vapor in the compressed air lines and air tools.

This system is said to be effective and economical. Current consumption is small and thermostatically controlled. About a quart of Frosto is required to treat 100,000 cu. ft. of free air under the worst conditions of temperature and humidity. Bulletin descriptive of Frosto and Tanner Gas freeze preventative systems can be had on application to Sullivan Machinery Co., Michigan City, Ind.

New Line of McKay Electrodes

★ A complete line of shielded-arc welding electrodes, claimed by the manufacturer to be quieter in operation, faster in welding time, offering finer bead appearance, and greater adaptability per rod—is announced by The McKay Company, Pittsburgh, Pa.

The makers state that, while the new electrodes are of an improved type, no changes in customary operating practice are required. In explaining their ability to produce a line of precision electrodes of higher efficiency the company advances three reasons: (1) A new plant at York, Pa., equipped with newly designed machinery; (2) Scientific development of the electrodes by a group of factory experts; (3) Supplemental work of an independent research organization.

A folder describing this line of electrodes may be obtained by writing to the Pittsburgh office of The McKay Company.

"Stoodex" for Hard Facing

★ The Stoody Co., Whittier, Calif., announces the development of "Stoodex," a new hard-facing metal. Stoodex is a free-flowing rod designed for application by the oxy-acetylene process only. Deposits have an average hardness of 50 on the Rockwell C scale. Stoodex, like other hard metals made by this company, is designed for specific purposes. Further information may be had by writing direct to the manufacturer, or by applying to Stoody district agencies.

Streamlined One-Piece Welders' Helmet

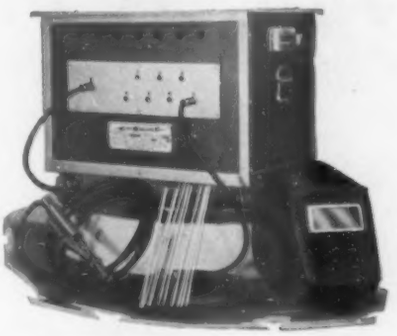
★ New one-piece seamless and rivetless welders' helmets and handshields equipped with Noviweld glass have just been announced by American Optical Co. Features listed for the various models include non-slip handles; modern plate holders; improved headgear and pads; and lift-front lens handles, ideal for rapid inspection without removing helmet. Noviweld plate is in lift-front, and clear lens in stationary section protects eyes when lift-front is up.

New one-piece welder's helmet.

To protect welders from dangerous and invisible rays, these helmets and handshields have been equipped with Noviweld glass. This glass, developed and manufactured under strict laboratory control, provides maximum protection against glare, ultra-violet and infra-red, chief hazards in welding.

"Blue Streak" A-C. Welder

★ Will-Weld Mfg. Co., Inc., 600 So. 15th St., Omaha, Neb., announces a new a-c. welder under the trade name "Blue Streak." Primary winding is designed for 110-220 volt power service and the unit has a 3-stage current switch—high, low, and off. The front of the machine has seven ground plugs to provide 14 different "heats", in uniform steps. Electrode and ground cable connections are made by means of tapered male and female plugs. Each "Blue Streak" unit is shipped complete with helmet, cables, electrode holder, and sample electrodes. It is claimed that this new unit will handle a-c. electrodes from 1/16 in. up to 5/32 in. without overload. Field tests, it is stated, have demonstrated the capacity of the welder to handle work within this range.

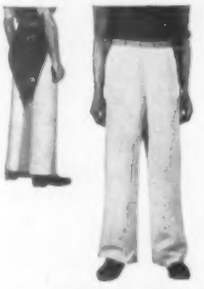


Blue Streak a-c. welder.

The maker offers a liability insurance policy free with each machine. Prices and any additional information that may be desired can be obtained by writing to the company.

Leather Chaps For Welders

★ The Industrial Gloves Co., 713 Garfield Blvd., Danville, Ill., has recently introduced a new chrome leather protector for welders, designated as Welders' Chaps No. 11508. These chaps cover the entire front of the body, from waist to foot, and are open in the back for coolness and convenience in use. An adjustable webbing assures correct fit. These welders' chaps also may be had with bib type apron of chrome leather attached, if so desired. The manufacturer will be pleased to furnish literature and complete information upon request.



Chrome leather welder's chaps.

WELDED HULLS FOR FISHING BOATS—The all-welded steel hull of the "Paramount", largest purseseine fishing boat in the world, allows her to carry 30 per cent more fish than she could if her hull were of wooden construction. Although the construction expense of this welded hull was approximately one-third higher than that of a wooden hull, insurance rates are more than cut in half, and maintenance costs are greatly lowered.

News of the Industry

LINCOLN AWARD PROGRAM—The deadline for contest papers entered in the Award Program of the James F. Lincoln Arc Welding Foundation is June 1st, 1938. Papers must be in the mail not later than June 1st. Men in the industry who have evidenced an interest in the Award Program should make an effort to complete their studies, prepare papers and send them in as soon as possible, because the time is getting short. The Award Program offers an opportunity to engineers and designers to do a constructive job for which they may be well repaid. It is stated that winning one of the awards will establish definite professional recognition for the winner and this factor should be considered as much as the possibility of winning a substantial cash prize.

"WELDING OF STEEL FRAME BUILDINGS" was the subject of a talk presented by A. M. CANDY, consulting engineer, Hollup Corp., Chicago, at a meeting held on March 11 by the WISCONSIN ARCHITECTS ASSOCIATION Builders Exchange, Milwaukee, Wis. Following Mr. Candy's talk, the subject of welded stainless and copper base alloys for architectural design was presented to the architects by E. J. BRADY, welding engineer, Hollup Corp., Chicago.

MARQUETTE UNIVERSITY, Milwaukee, Wis., celebrated its first annual Marquette Engineers' Day on Saturday, March 12. In order to acquaint engineering alumni with recent advances in welding, the program was planned to provide two speakers to discuss welding subjects. A. M. CANDY, consulting engineer in charge of welding machinery division, Hollup Corp., Chicago, spoke to the alumni on the subject "Recent Trends and Applications in Welding." He illustrated his talk with numerous lantern slides, most of these slides tracing the development of structural welding, in which Mr. Candy was one of the pioneers. E. J. BRADY, welding engineer in charge of stainless and alloys division of Hollup Corp., spoke on the fundamentals of electric arc welding, with particular emphasis on his specialty, the welding of stainless and alloy steels. An operating exhibit of welding equipment was set up in one of the rooms in the Engineering Building, including a D-C. motor-generator set, a vacuum tube rectifier D-C. set, and an A-C. transformer welding set.

THE OMAHA WELDING CO., 1501 Jackson St., Omaha, Nebr., announces a registration of 407, as compared with 296 in 1937, at its recent annual welding conference, March 2-4. One of the men attending the conference, FRANCIS X. DAVIDSHOFER of Smithwick, S. Dak., traveled 640 miles to attend the meeting. Following is a list of companies which exhibited equipment and had representatives in attendance:

American Steel & Wire Co.; Haynes-Stellite Co.; Hobart Bros. Co.; Linde Air Products Co.; Nickel Chromium Plating Corp.; Osmundson Spade Mfg. Co.; Page Steel & Wire Co.; Sellstrom Mfg. Co.; Shawinigan Products Co.; Smith Welding Equipment Corp.; Spitz Foundry; Titan Metal Mfg. Co.; United States Rubber Co.; *Welding Engineer (The)*; Will-Weld Mfg. Co. On March 3rd those in attendance had an opportunity to assist in the formation of Omaha Section, American Welding Society. At a dinner meeting held that day, H. C. BOARDMAN, research engineer, Chicago Bridge & Iron Co., and regional vice-president of the A.W.S., spoke on the subject of field and shop welding of storage tanks.

A feature of the Omaha Welding Co. conference was the liberal amount of practical information on shop technique available to those who most needed this knowledge. Equipment and materials were available for those who wanted to try their hand at an operating demonstration.

THE TEXAS TECHNOLOGICAL COLLEGE (Lubbock, Tex.) welding conference had a total registration of exactly 400, which is far in excess of previous conferences. The exhibits were greater in number and the caliber of those in attendance was likewise higher than at previous meetings. A high spot of the conference was the welder's banquet on February 3, 1938. An examination of the menu revealed this appetizing list of delicacies:

Chief Gas Generator (L. C. Monroe)
Work Specifications
Welder's Brains (Shrimps)
Salad Sprayed with Tungsten Dressing (Mayonnaise Dressing)
White Metal Smothered in Carbon Paste (White Turkey with Dressing)
Sweetened Bronze Flux (Sweet Potatoes)
Green Inserts (Green Peas)
Hot Rolled Ingots (Hot Rolls)
Frozen Slag (Chocolate Ice Cream)
Liquid Carbon (Coffee)
Carbon Electrodes—½ in. (Cigars)

FOURTH ANNUAL WELDING CONFERENCE
University of Kansas
Lawrence, Kan.

Thursday Morning, March 31st

9:30 Chairman, F. A. RUSSELL, *professor* civil engineering, University of Kansas.
Maintenance and Repair of Heavy Construction Equipment: T. B. JEFFERSON, assistant plant engineer, U. S. Engineers Dept., Fort Peck, Mont.

10:30 Engineering Convocation
Welcome: DR. E. H. LINDLEY, Chancellor, University of Kansas.
Address: Welding at the A. O. Smith Corp. Milwaukee, Wis.: WM. E. CRAWFORD, chief engineer.
Metal Inspection and Magnaflux Methods: J. W. VALE, educational director, T.W.A., Kansas City, Mo.

Thursday Afternoon, March 31st

Chairman, LA MOTTE GROVER, Dept. of Applied Mechanics, Kansas State College, Manhattan, Kan.

1:30 Code Procedure Under Section U-69, A.S.M.E. Unfired Pressure Vessels: ED. H. GILL, chief engineer, Columbia Steel Tank Co., Kansas City, Mo.
Developments in Welding: G. F. DICKENS, manager Air Reduction Sales Co., Kansas City, Mo.
Hard Surfacing: W. S. TROMLEY, district sales manager, Haynes Stellite Co., Tulsa, Okla.
Metal Spray: HUGH LIBBY, Libby Radiator Works, Kansas City, Mo.
Demonstration at Fowler Shops.

Thursday Evening, March 31st

Demonstration at Fowler Shops: W. R. CLARK, JR., manager, Kansas City Branch, Linde Air Products Co., Metal Cutting, Metal Coating, Flame Hardening and Lindewelding.

Friday Morning, April 1st

Chairman, R. W. WARNER, professor and head of Dept. of Electrical Engineering, University of Kansas.

9:00 Training Welders for the Oil Field Industry: L. T. DETLOR, Carter Oil Company, Seminole, Okla.

Part of the "400" who attended the Lubbock, Texas welding conference, February, 1938.

Meetings

March 21-25, 1938

Western Metals Congress and Exposition, Pan-Pacific Auditorium, Los Angeles, Calif. In conjunction with Pacific Coast Sections of American Welding Society and American Society For Metals. Meetings of A. W. S. will be held at Biltmore Hotel.

March 22-24, 1938

Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa.
"Annual Welding Conference" — Program and arrangements are being handled by D. C. FABER, director of engineering extension service.

March 31st-April 1st, 1938

University of Kansas, Lawrence, Kans., fourth annual welding conference. Further information can be obtained from A. H. SLUSS, professor of mechanical engineering.

May 14-21, 1938

International Petroleum Exposition & Congress, Exposition Grounds, Tulsa, Okla.

May 31-June 2, 1938

Heating, Piping and Air Conditioning Contractors National Association, 1250 Sixth Ave., New York City.
Annual Convention (49th)—Boston, Mass.

June 20-22, 1938

Society of Chemical Industry, 305 Washington St., Brooklyn, N. Y.
Annual meeting in Ottawa, Ont.

June 20-24, 1938

American Institute of Electrical Engineers, 33 W. 39th St., New York City.
Summer convention at Washington, D. C.

June 27-July 1, 1938

American Society For Testing Materials, 260 So. Broad St., Philadelphia, Pa.
Annual meeting at Chalfonte-Haddon Hall, Atlantic City, N. J.

August 9-12, 1938

American Institute of Electrical Engineers, 33 W. 39th St., New York City.
Pacific Coast convention at Portland, Ore.

October 10-14, 1938

American Institute of Steel Construction, Inc., 200 Madison Ave., New York City.
Annual meeting at French Lick Springs, Ind.

October 17-21, 1938

National Metals Congress & Exposition, held in conjunction with American Welding Society, American Society for Metals, American Society of Mechanical Engineers, American Institute of Mining & Metallurgical Engineers, and The Wire Association. Annual meeting in Detroit, Mich.

(Program Continued—University of Kansas)

Arc Welding Electrode Coatings: F. EMERY GARRIOTT, metallurgical engineer, J. D. Adams Co., Indianapolis.

Flame Hardening: F. C. HUTCHINSON, chief development engineer, Kansas City District, Linde Air Products Co.

Boiler Manufacture and Repair: D. J. CODY, Cody Boiler Works, Kansas City, Mo.

Friday Afternoon, April 1st

Chairman: C. A. WOODMAN, purchasing agent, Kansas City Bridge Co., Kansas City, Mo. Chairman, Kansas City Section, A.W.S.

1:30 Pipe Line Welding by the Electric Welding Method: HAROLD C. PRICE, manager, H. C. Price Co., Bartlesville, Okla.

Welding in the Petroleum Industry: W. M. B. BRADY, welding specialist, General Electric Co., Chicago, Ill.

Address: P. G. LANG, JR., chief bridge engineer, Baltimore & Ohio Railroad, and President American Welding Society.

Friday Evening, April 1st

Annual Meeting, Kansas City Section, A.W.S., Hotel Kansas Citian, Kansas City, Mo.

Personals

W. P. WITHEROW, president of the Blaw-Knox Co., Pittsburgh, Pa., has announced the appointment of N. B. ORNITZ as president of the Power Piping Division of the Blaw-Knox Co., and of W. N. QURTZ, as vice-president in charge of operations. Mr. Ornitz, a director and a vice-president of the Blaw-Knox Co., will also continue the management of the National Alloy Steel Division.

R. A. HENDRICKSON, who has been in the employ of Crane Co., Chicago, for 20 years, has been appointed manager of the Oil Sales Section. For many years Mr. Hendrickson had charge of the design of steel products to meet the conditions of increasing pressures and temperatures.

JAMES BOYD, formerly assistant eastern district manager, has been appointed eastern district manager of the Westinghouse Electric & Mfg. Co. As eastern district manager, he succeeds H. F. BOE, who has become commercial manager of the company, with offices in Pittsburgh. Mr. Boyd's headquarters will be in the Westinghouse Building at 150 Broadway, New York.

HARRY T. BENNETT, who has spent 40 years in the steel industry, has retired as special sales representative of the Carnegie-Illinois Steel Corp., Chicago office. In addition to his business activities, Mr. Bennett has served as alderman, mayor, and as a member of the school board in Des Plaines, Ill., and is connected with the First National Bank of that city.

LEWIS M. PARSONS has recently been elected vice president in charge of sales and a director of the Jones & Laughlin Steel Corp., Pittsburgh, Pa. After leaving University of Pennsylvania in 1917, Mr. Parsons entered the employ of the Bethlehem Steel Co. in the sales division. He was made assistant manager of sales, Philadelphia office, in 1932, and manager of sales at the same office in 1936. With Jones & Laughlin, effective March 1st, he will have entire charge of all sales activities, including supervision of district sales offices.

UNA WELDING, INC., 1615 Collamer Ave., Cleveland, Ohio, announces election of new officers and executive appointments as follows: W. B. BAKER has been appointed treasurer and general manager; R. B. FEHR has been appointed chief engineer of research and development; A. C. GILCHRIST has been appointed plant superintendent and D. E. WILSON has been made office manager.

GEORGE H. BUCHER, executive vice president of the Westinghouse Electric & Mfg. Co., has been elected president of the company. FRANK A. MERRICK, president since 1929, was elected vice chairman. The announcement was made by A. W. ROBERTSON, chairman, following a meeting of board of directors. PAUL JUDSON MYLER, president of the Canadian Westinghouse Co., became a director of the Westinghouse Electric & Manufacturing Company at the same meeting.

J. K. B. HARE, has been appointed Central District Manager of the Westinghouse Electric & Mfg. Co. JOHN ANDREWS, JR., former district manager, joins the headquarter's staff of the company as assistant to vice-president in charge of sales. He will retain his offices in Pittsburgh. Mr. Hare, who has been with Westinghouse since 1919, will have charge of the sales

district of the company whose headquarters are in Pittsburgh and whose territory includes the tri-state district.

THE STEELWELD MACHINERY CO., Cleveland, Ohio, announces the appointment of LEE B. GREEN as general manager. Mr. Green was general master mechanic of the Timken Roller Bearing Co., Canton, Ohio, for many years, and later became superintendent of the Lincoln Motor Co., Detroit, Mich. Prior to his present connection, he was vice president and works manager of the Globe Machine & Stamping Co., Cleveland, Ohio.

WILLIAM COLTON, formerly designing engineer with the Chevrolet branch of General Motors Corp., has been added to the staff of the Roth Welding Engineering Co., 17146 Mt. Elliott Avenue, Detroit, Mich.

A. W. S. Activities

DETROIT SECTION, A. W. S.—A meeting of all officers and committees of Detroit Chapter, A. W. S., was held on February 15th, at 19,000 Fairway Drive, Detroit, to discuss various problems of the Society and also plans for the coming annual convention to be held in October.

LOS ANGELES SECTION, A. W. S.—"Geophysical Determination of Oil and Mineral Deposits," was the subject of an address given by DR. BENO GUTENBURG, at the regular February meeting of the Los Angeles Section, held during the evening of the 17th at the Central Manufacturing District Club Rooms, 4814 Loma Vista Ave. Discussion was under direction of the section's new chairman, P. D. MCELFISH, who presided at the meeting.

SAN FRANCISCO SECTION, A. W. S.—This section held its regular February meeting Friday evening, the 18th, at the Athens Athletic Club, Twelfth and Clay Sts., Oakland, Calif. Main topic of the evening was an interesting talk by M. S. CLARK, president of Federal Machine and Welder Co. Warren, Ohio. Mr. Clark's subject was, "Latest Developments in Resistance Welding." Chairman N. F. WARD presided.

CLEVELAND SECTION A. W. S. at its meeting March 9th listened to HARVEY BASS, of the New York Central Collinwood Shops, discuss the subject "Machine Gas Cutting of Locomotive Parts."

KANSAS CITY SECTION A. W. S. at its meeting February 22nd was addressed by E. W. P. SMITH, consulting engineer of The Lincoln Electric Co. Mr. Smith's subject was "Structural Steel Construction by the Electric Arc." His talk was illustrated with several slides.

NORTHERN NEW YORK SECTION A. W. S. at its meeting February 17th discussed brazing and soldering with the help of two experts in this field: LEO EDELSON of Handy & Harman and WALTER REED of General Electric Company's Pittsfield works.

MILWAUKEE SECTION A. W. S. at its meeting of March 10th had an opportunity to hear DR. S. L. HOYT, director of metallurgy of A. O. Smith Corp. Dr. Hoyt presented the subject of "Metallurgical Studies of Arc Welds." His talk was built around the improvement in quality of weld metal, which has been responsible for the widespread use of arc welding.

PHILADELPHIA SECTION A. W. S. at its meeting February 21st was addressed by G. A. JESSOP of S. Morgan Smith Co., York, Pa. Mr. Jessop's subject was "The Use of Castings in Heavy Welding Assemblies." At its March 21st meeting the Philadelphia Section will discuss the subject of high yield strength alloys and their fabrication. Program indicates that an engineer of the U. S. Steel Corp. will present the subject for discussion.

T. R. LICHTENWALTER, welding engineer for the Alloy Steel Division of Republic Steel Corp., Cleveland, Ohio, addressed the New York Section at its March 1st meeting held at Polytechnic Institute, Brooklyn, N. Y. He presented the subject: "Welding the High Chromium and Chromium-Nickel Stainless Type Alloys."

DETROIT SECTION A.W.S.—At its last meeting, March 17, Detroit Section heard R. W. BRENDLE, of Great Lakes Engineering Works, describe the welded construction of two new freighters. VAUGHAN REID presided as chairman of the meeting.

CHICAGO SECTION, A.W.S.—"Heat Effect in Welding" was the subject of an interesting talk presented on March 18th, by DR. W. G. THEISINGER, welding and metallurgical engineer, Lukens Steel Co., Coatesville, Pa. Dr. Theisinger discussed the effect of welding heat on parent metal adjacent to the weld, effect of carbon content on hardness, and relation of carbon content to welding speed. His answers to these and many other questions were based on his extensive research work on the heat effect in welding.

PITTSBURGH SECTION, A.WS.—EVERETT CHAPMAN, president, Lukenweld, Inc., Coatesville, Pa., spoke on the subject "Welded Steel Construction with Special Reference to Stresses, Design, Metallurgy and Heat Treatment." He illustrated his subject with a movie film, "Heat Stresses and Mechanical Stresses in Welds," also using several slides where they helped to clarify his talk.

INDIANAPOLIS SECTION A.W.S.—Held a joint meeting with the Indiana Engineering Council on February 25th at Hotel Lincoln, Indianapolis, Ind. L. W. WALLACE, director of research and development, Crane Co., Chicago, spoke on the subject "The Engineer and Civilization." At this meeting plans were discussed for an Engineer's Club Room for members of engineering societies in the Indianapolis area.

SAN JOAQUIN VALLEY SECTION, A.W.S.—The first meeting of the Section under its charter was held in the evening of February 24th, at the American Legion Hall, 600 "D" St., Taft Heights, Calif. Over 100 members and guests were present, including officers, members and guests from Los Angeles and San Francisco Sections. K. V. KING, of the San Francisco Section, formally presented the new section with its charter. P. D. MCELFISH, in behalf of officers and members of the Los Angeles Section, presented charter members of the new section with society pins. Chairman B. RINTOUL presided.

Trade News

NEW PROCESS PLOW WELDING CO., Perry, Iowa, has appointed the WAYNE WELDING SUPPLY CO., INC., 517 E. Wayne St., Fort Wayne, Ind., as jobbers for the state of Indiana. Wayne Welding Supply Co. formerly covered the northern half of Indiana for New Process Plow, but effective February 1st will cover the entire state.

COMMERCIAL ACETYLENE SUPPLY CO., INC., announces a change in its Chicago office from 600 West Jackson Blvd. to 3100 S. Homan Ave.

HARNISCHFEGER CORP. of Milwaukee, Wis., announces the appointment of the DEADERICK MACHINERY CO. of Knoxville, Tenn., as the representative for its line of P&H-Hansen Smootharc welders and welding electrodes in Eastern Tennessee. This concern, in addition to handling mining equipment and a complete line of machine tool and industrial equipment, will represent the P&H line on an open basis.

ARCOS CORPORATION, Philadelphia, Pa., has appointed the INDUSTRIAL SPE-

"To say I'm sold on Tobin Bronze is putting it mildly. For more than 20 years, I have used this welding rod... and today all of us prefer it to any other. Why? Because Tobin Bronze is more economical to use and helps my men make better, more dependable welds."—C. G. Blackwell, Dayton Welding Co., Dayton, Ohio.

Broken castings made "like new"

Tobin Bronze enables welders to reclaim broken castings which otherwise would need to be replaced at great expense

The danger of cracking and warping prohibited the use of methods involving preheating for the welding of this unsupported cast-iron platform. Tobin Bronze made furnace preheating unnecessary and the low welding temperature minimized risk of distortion and shrinkage.

A thrilling book could be written of the many spectacular "rescues" made by welders with the aid of Tobin Bronze! A wheel or other part breaks... the factory is at a standstill... the only solution seems to be a new part. Faced with a long shutdown and high expense, someone who "knows" suggests Tobin Bronze Welding.

Straightway the broken casting is made "like new" at ridiculously small expense.

Extensive preheating is usually unnecessary for Tobin Bronze welding. Welds are made by heating the surface of the weld area to a red heat only. Thus Tobin Bronze welding saves time, gas and money, and reduces the possibility of distortion.

This time-tried Anaconda welding rod carries the trade-mark "Tobin Bronze registered U. S. Patent Office" on each rod. Look for it—get the genuine.

ANACONDA

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONNECTICUT

Offices and Agencies in Principal Cities · In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ontario

CIALTIES Co., Portland, Ore., as distributors for stainless and other special electrodes in the Northwest.

THE HARNISCHFEGER CORP., Milwaukee ,Wis., announces the appointment of the LYONS MACHINERY Co., Little Rock, Ark. as sales representative of P&H Hansen Smootharc welders and Smootharc welding electrodes. The Lyons Machinery Co. has acquired this agency on an open basis, and its territory includes the entire state of Arkansas.

MACHINERY & WELDER CORP. with main office in St. Louis, Mo., announces the opening of a branch office in Wichita, Kan., under the management of R. M. ARMSTRONG.

LUDLUM STEEL Co., Watervliet, N. Y., has appointed GERALD D. HOWK as its mill representative in the Cincinnati territory. His headquarters will be in the offices of Julius Uihlein & Co., 208 Elm Street, Cincinnati, Ohio.

THE BLACK & DECKER MFG. Co., Towson, Md., announces the opening of a factory service branch at 630 Baronne St., New Orleans, La. This is the 22nd factory service branch to be established by the company in the United States.

KING LABORATORIES, INC., 305 Oneida St., Syracuse, N. Y., who have manufactured Tyler's aluminum flux for the Syracuse Welding Co., according to their formula, announce that they have recently acquired the sales rights for this material from the welding company. This step was taken to assure prompt and careful attention to deliveries.

GEORGE SMEDLEY has rejoined the sales force of Torchweld Equipment Co., 1035 W. Lake St., Chicago. Mr. Smedley worked for Torchweld as a service man during the years 1920-22 inclusive.

TORCHWELD EQUIPMENT Co., 1035 W. Lake St., Chicago, announces that Welding Equipment & Supply Co. has been appointed Toledo district representative. This company also represents Torchweld in the Detroit district.

TORCHWELD EQUIPMENT Co., 1035 W. Lake St., Chicago, announces the addition of a complete line of arc welding electrodes, both bare and shielded arc, for distribution to the trade under their own brand name.

Construction

THE GENERAL PETROLEUM CORP. of Calif. has awarded a contract to the Soule Steel Co. of Los Angeles, for the construction of an all-welded steel frame office building. The new building will be approximately 150 by 80 ft.

AN OIL TANK FARM of all-welded steel storage tanks will be constructed shortly by the Petrol Corp. of Los Angeles. The location of the tanks is near Santa Barbara County beach park. Bechtel & McCone, Los Angeles welding contractors, have the contract for construction of the tanks.

WORK HAS BEEN STARTED in Sequoia National Forest (Northern California) on a new welded steel and concrete bridge over the North Fork of Tule river, near the Blue Ridge lookout station.

A SIX-INCH WELDED oil pipe line will be constructed in the near future by Barbour & Woods, oil producers, of Houston, Texas. The line, 28 miles long will extend from the Lisbon (Texas) oil field to a point near Minden, La.

THREE WELDED PIPE LINES are being planned by E. L. Buckley & Associates, of San Antonio, Texas. The lines will be four and six inches in diameter, and will be laid in the oil fields of the Prement and North Sweden districts. Total length of lines will be about 65 miles.

A LARGE AMOUNT of welding entered into the fabrication and installation of equipment for a 600-ton ore treating mill for the Getchell Mining Co. near Galconda, Nev.

OKLAHOMA PIPE LINE Co. has been awarded contract for approximately 21 miles of 8-in. pipe from Ardmore, Okla., north. The entire pipe line will be oxy-acetylene welded by the Lindeweld method.

CONSTRUCTION OF A SECOND 18,500-TON welded tanker for The Atlantic Refining Co. has been started by the Sun Shipbuilding & Dry Dock Co., Chester, Pa. The vessel is scheduled for delivery early in August, 1938. The "J. W. Van Dyke," a tanker of the same tonnage and welded construction launched from the Sun Shipyards in November, is scheduled for early delivery to The Atlantic Refining Co. These two tankers are the world's largest welded ships now under contract.

PENNSYLVANIA SHIPYARDS, INC. of Beaumont, Texas, recently launched the Gulf Oil Corporation's motor vessel "PARATEX." This new vessel is of arc welded construction, 257 ft. 9 in. long, 43 ft. beam, 17 ft. 6 in. deep, and of 20,000-barrel capacity. She is for canal service and has telescopic masts, stacks and pilot house to permit passage under low bridges. Pennsylvania Shipyards, Inc., according to its president, CHARLES T. SAMUELSON, has constructed a total of 151 vessels of 100% arc welded construction.

The Improved "Round File" Gas Lighter

Immediate Ignition Assured

The Hood of the Improved "Round File" Gas Lighter is so designed as to form a "pocket" for the gas—an exclusive feature—which assures IMMEDIATE ignition. Get acquainted with the many other superior, exclusive features of Improved "Round File." *Circulars and prices on request.*

SAFETY GAS LIGHTER CO. (Est. 1901) **LYNN, MASS.**

H. C. PRICE Co., Bartlesville, Okla., has been awarded a contract by Ostrom Realty & Construction Co. for the electric welding of approximately 160 miles of 8-in. line for the Shell Petroleum Corp., from the Illinois-Indiana line to the Indiana-Ohio line.

THE MARIETTA MFG. CO., Point Pleasant, W. Va., has been awarded a contract for the construction of a welded towboat for the Inland Waterways Corp. at a cost of $197,000. It will be a shallow draft, twin screw type boat, of 1,000 hp.

THE WILMINGTON (CALIF.) GASOLINE Co. plans the early construction of two 8-in. and one 4-in. welded submarine pipelines across the channel to Long Beach harbor. The larger lines will be used for wet gas, the smaller one, for dry gas.

GENERAL PACKING Co., Los Angeles, will erect, in the near future, an expansion refrigeration plant. This job will involve welded construction. Estimated cost of the job is about $10,000.

THE UNION OIL Co. of Calif. is laying 15,000 ft. of 8-in. welded pipelines in the vicinity of Long Beach.

A WELDED PIPELINE 1,350 miles in length may be constructed in 1938 in the middle west by a number of oil refineries in that area, who are seriously considering the project, in view of a 15 per cent increase in freight rates which was sought by the railroads. The lines would be six, eight an dten inches in diameter, and the total expenditure for the project would aggregate around $12,000,000, it is stated.

A CONSIDERABLE AMOUNT OF WELDED PIPING and welded tank construction will enter into the expansion program of the Proctor & Gamble Soap Co. in its Long Beach (Calif.) plant. A new $104,000 building will be erected for oil processing, storage, etc.

THE SOUTHERN CALIFORNIA GAS Co. recently completed two large welded steel gas tanks at Redlands, Calif. Each tank has a capacity of 250,000 cu. ft. and provides storage for needed reserve supply of fuel.

BARNSDALL OIL Co. has recently completed a 6,000,000 cu. ft. casing head gasoline plant in Ector County, Texas. A considerable amount of welding entered into this job.

Foreign News

WELDED STEEL BARRELS FOR GASOLINE STORAGE

A new system for the storage and easy transport of gasoline and other liquids has recently been developed in France. The system involves storing of gasoline in barrels.

The barrels are of welded steel construction with slightly tapering ends. The head and bottom are of pressed steel, welded on, and are provided at their centers with a small pressed steel cup welded into a hole cut for the purpose. At the limit of the cylindrical center portion a series of small clamps is welded on to the barrel for fastening solid rubber tires. This permits the barrel to be rolled without difficulty. The bung-hole is formed in one of the tapered sections and is closed by a screw cap which fits in flush.

The barrels are especially intended for transport by means of a special frame which converts them into wheels for movement. This frame is of welded pressed steel, forming a square U shape, the fourth side of the frame

New!

STANDARD 2-BRAID HOSE

—joined by the famous "SIAMEEZ" web

ELECTRIC-SIAMEEZ answers your request for average-duty hose with the tangle-proof, snag-proof feature

Here is the hose which hundreds of welders have asked us to make . . . two-braid construction, with the famous "SIAMEEZ" web joint that keeps the lines from tangling, kinking and snagging. "Electric-SIAMEEZ" is exactly right for welding and cutting with pressures up to 200 pounds.

Its two layers of braided reinforcement provide plenty of strength for average duty. Its extra thick and tough cover assures long life in rough work. And, it has exceptional flexibility which adds maximum handling ease.

Another advantage is found in the fact that this new "Electric-SIAMEEZ" is made in three sizes . . . 1/4", 5/16" and 3/8" diameters. Write us for full details, prices and names of local distributors.

Other Grades with the SIAMEEZ joint—
For light duty you can get Junior-SIAMEEZ, a single braid hose. For higher pressures and hardest service, use Supero-SIAMEEZ. It has an extra spiral reinforcement between two layers of braid.

ELECTRIC HOSE & RUBBER CO.
WILMINGTON, DELAWARE

ELECTRIC Siameez

Product of The Hose Specialists

ELECTRIC HOSE & RUBBER CO.

being formed by a removable bar which bolts on to the ends of the U with wing nuts.

On this frame bearings are provided to fit into the cups in the head and bottom of the barrel. These cups consist of a solid piece, which fits into the cup and which turns on ball bearings on a short axle fixed to the frame. In this way, whenever the bearings are subjected to a strain sufficient to deform them, the extra strain is taken up by the bands. At either side of the frame, a coupling rod and a pair of crossed chains are provided to permit the frame to be connected to a tractor or to allow several frames to be coupled together. This coupling is sufficiently rigid to permit the barrels to be either pulled or pushed.

The system allows the transport of considerable quantities of gasoline without the use of tank trucks, and also permits storage in a confined space or in temporary shelters, such as would be found in a war zone. The use of rubber tires makes it possible to draw the barrels along the road without difficulty, while the welded construction of the barrel lends itself admirably to transport over rough ground. The frames round the barrels prevent them from bumping and damaging each other. By the removal of the frames the barrels can be stored in small underground pits, where a stack of six barrels would represent a supply of over 1,400 gal.

These novel barrels have been developed by the French Tecalemit Co.

Hydraulic Press Heads Repaired by Welding

The repair of two large hydraulic press heads by welding at a British cable factory constituted one of the largest welding repair jobs ever carried out in the United Kingdom. The heads concerned formed parts of two large hydraulic presses employed for the extrusion of lead sheathing for high-tension electric cables.

A few months ago cracks appeared in the head of one of the presses, which at the time was employed on important contracts. The cracking of the head of the first press also acted as a serious check on output, but the situation became far worse, when a few days later, the head of the second press broke across the middle. At the present state of industrial activity it might have taken months to obtain new heads. Hence a welding concern, Barimar, London, was asked to repair the heads.

The heads, which are of box section, 6 ft. 6 in. long by 3 ft. 6 in. wide, weigh nearly 17 tons each. The fractures passed through metal varying in thickness from 3 in. to 5 in. The problem was met by first attending to the cracked head, this being the smaller job of the two. This allowed production to start with minimum delay. The repair was made without removing the head from the press. Day and night shifts were employed to speed the job.

The magnitude of the repair job may be gleaned from the fact that more than a ton of welding material was used. Repair of these presses by welding enabled the cable company to complete its important contracts by the specified delivery date.

Oxygen Jet Accomplishes Deep Cutting in Steel

An interesting demonstration of the deep-cutting capabilities of the oxy-acetylene jet was provided recently when a hydraulic accumulator was reconditioned at the British Xylonite Co's. works in London.

The ram of the accumulator, which was loaded with about 90 tons of concrete, had become scored, but it was impossible, in the time allowed for the job, to rebore the cylinder and fit a new ram of correspondingly increased diameter, or to build up the diameter of the existing ram by fitting a liner, or employing any process of metal deposition. It was decided to skim the ram and attach at the upper end of the cylinder a new gland section, bored to suit the reduced ram diameter and provided with a tail sleeve to fit within the existing stuffing box. The overall finished length of the extension piece was 1 ft. 10 in.

A forged steel billet 25 in. long, for the requisite diameter, was obtained by cutting a length from an old marine propeller shaft. This shaft was solid and, to bore out the 10 in. diameter hole for the ram would have been too costly and time consuming. The possibility of cutting out a central core by means of an oxy-acetylene jet was submitted to the British Oxygen Co., who considered it practical, using a standard 55 in. type of cutting machine.

To start the cut, a hole 1 in. in diameter was machine-drilled through the billet, this job taking 90 min. The heating flame was then applied to the metal around the hole for a period of 10 min., after which the cut was commenced with the machine set to a speed of 14 ft. per hr. The oxygen nozzle employed was the largest size made, having a bore of 11/64 in. It was supplied with oxygen at a pressure of 120 lb. per sq. in. from a battery of four cylinders coupled together, four more cylinders containing the supply of acetylene. Within 10

Ryerson a dependable source for Welding Rod

● Ryerson Engineers have developed a series of rods that are outstanding for Quality production. More than twenty types, including both electric and gas rods, are carried in stock. Whether you need a shielded arc type for production work or a stainless steel rod you can be sure of immediate shipment... *Write for Bulletin which gives complete data.*

ELECTRODES

Ryerson
Shielded Arc Type No. 215
Shielded Arc Type No. 216
Shielded Arc Type No. 217
Green Processed No. 18
Copper Coated No. 206
Copper Coated No. 210
Cast Iron

Ryerson
Green Processed No. 6
Bare Mild Steel
Brown Processed
White Flux Coated
High Carbon White Flux Coated
Blue Flux Coated

GAS RODS

3½% Nickel Steel High Carbon Bare No. 2110

Ryerson
3½% Nickel Steel Flux Coated
High Manganese Steel Hard Surfacing
Allegheny Stainless Flux Coated
Allegheny Stainless No. 44

Tobin Bronze
Allegheny Stainless Bare Hard Filler

JOSEPH T. RYERSON & SON, Inc., Chicago, Milwaukee, St. Louis, Detroit, Cleveland, Cincinnati, Buffalo, Boston, Philadelphia, Jersey City

min. the cut was completed and the core had been removed (8 in. diameter and 25 in. long).

The total consumption of gas, including that used in pre-heating, amounted to 400 cu. ft. of oxygen and 100 cu. ft. of acetylene. The billet was not distorted in cutting and the cut surface of the steel presented no difficulty in machining to the completed form required.

Japan's 410-ft. Welded Rails

Japanese government railway engineers will electrically weld the joints of new rails to be laid in the 11,230 ft. stretch of the Monomi tunnel on the Inaba-Mimasaka line of the government railway, connecting Tottori with Tsuyama city. This is said to be the first experiment of its kind ever made by the Japanese government railways.

Each rail in the tunnel is 25 meters (82 ft.) long. The railway engineers will group five such rails, weld them electrically, and assemble them into a unit 125 meters (410 ft.) long. This process, besides minimizing the use of joint plates, tie plates, and spikes at the joint, will eliminate the rail end bumping at the joints.

In the Monomi tunnel the usual space at the joints for expansion of rails is not needed because the temperature is practically constant throughout the year. Furthermore, the peculiar geology of the tunnel has made rails and accessories, particularly at joints, corrode rapidly. Despite the fact that the tunnel was opened in 1932, the rails within the tunnel already require replacement.

Should the experiment prove satisfactory, the railway engineers will apply electric welding to rails in most of the other tunnels on the government railways.

Trade Literature

Eye Protection Guide—A chart which specifies types of safety goggles to wear for protection against eye hazards in all principal industries has just been completed by the Safety Engineering division of American Optical Co., Southbridge, Mass. Upon request, it will be sent to any industrial concern without cost. Probably the most complete chart of its kind, it classifies eye hazardous operations by industries and recommends specific types of eye protection equipment which have been devoloped for each hazard.

"New Advance in Arc Welding Equipment Design"—F. J. Hirner, welding engineer of the Harnischfeger Corp., Milwaukee, Wis., has recently completed a 12-page booklet in which he explains some of the developments recently made in arc welding. Using oscillograms to study generator characteristics in "slow motion," Mr. Hirner illustrates the fly wheel and governor effect of the arc and explains the auxiliary excitation system of the Hansen arc welder. The booket also contains an explanation of the relationship of volt-ampere curves to arc heat. Copies of this booklet may be obtained by writing the Welding Division of Harnischfeger Corp., 4400 W. National Ave., Milwaukee, Wis.

"Tweco Electrode Holders" is the subject of a folder just issued by Tweco Products Co., 111 W. Third St., Wichita, Kan. Constructional features of the Tweco holder are illustrated. Prices are included for the various capacities of Tweco holders.

Eye Protective Equipment, including goggles, spectacles, lenses, helmets, etc., of every type and design used by workers in the welding, mining, construction, automotive, steel, petroleum, machinery, glass, quarry and other industrial fields are fully described and illustrated in a new brochure entitled, "Eye Protection." Copies of this informative publication, just off the press, are available by writing direct to the Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.

"Hard-Facing for Rural Shops" is the title of a recent booklet issued by Stoody Co., Whittier, Calif. As its title indicates, the book is intended for shop owners in rural sections of the country. In addition to recommended methods of hard-facing agricultural implements, the book contains helpful information on cost accounting and estimating costs of jobs.

A QUALITY PRODUCT MADE BETTER

★ ★ ★

ADAMS ARC-CRAFT "55" AND ARC-CRAFT "70"

now made with EXTRUDED COATING

● These two Adams products were introduced just one year ago and have been widely accepted for the exceptional quality of fusion metal which they produce. The adoption of extruded type coating now combines with the already desirable features of tough, strong fusion metal, the added characteristics of unexcelled arc action and ease of handling . . . Arc-Craft "55" is a high-speed electrode used with reverse polarity in all positions and adaptable to all classes of work, including pressure vessels. Arc Craft "70" is equally fast and is used with straight polarity in all positions; it is especially adaptable to work having poor fit up.

Adams representatives (located in principal cities) will gladly prove the superior quality of these electrodes by tests in your own shop.

Adams offers all kinds of bare, processed and heavy-mineral-coated electrodes for the welding of mild steel, stainless steel, manganese steel and aluminum and a complete line of DC and AC arc welders, engine-driven welders, automatic welding heads and accessories.

J. D. ADAMS COMPANY · INDIANAPOLIS, INDIANA
Welding Division

ADAMS ARC WELDING ELECTRODES

Classified Section

ADVERTISING RATES
Help Wanted—75c per line, minimum 4 lines. Jobs Wanted—4 lines free. Other Ads—$1.00 per line, minimum 4 lines. Count 8 words to line. Add 6 words for keyed address.

FOR SALE

FOR SALE—One Hercules Power Take-off Model S. D. 706 with shaft, two pulleys, universal joints and four vee belts. High speed for welding equipment. Will sell reasonable. W. M. Griffith, 570 E. Chestnut St., Coatesville, Pa.

FOR SALE—50, 75 and 100 amp. Lincoln vertical arc welders, like new, cheap. 200-amp. Lincoln, 300-amp. Westinghouse and Hansen; 400 amp. Lincoln and Una welders. Many others. 3 in 1 METALLIZER SPRAY GUN like new $175. New Aladdin A-C. welder $25. New Thor A-C. welder $90. 4,000 ft. rubber-covered super flexible welding cable, overstocked new cable, cheap. Address Mar-1, The Welding Engineer.

BARGAINS—Demonstrator arc welders. Gasoline and electric drive. 30 days' trial. Easy terms if desired. Write Hobart Welder Exchange, Box U-381, Troy, Ohio.

USED WELDING MACHINES—4 Lincoln 200 amp. 230 V.—DC drive, 2 Lincoln 300 amp. 230 V.—DC; 1 Westinghouse 200 amp. 230 V.—DC; 3 Lincoln 300 amp. with 220 V., 60-cycle, 3 phase motors. All have been overhauled and are guaranteed good operating condition. All are portable, two-bearing units on steel frame trucks. Address P. O. Box 853, Indianapolis, Ind.

FOR SALE—General shop, 60 by 100 concrete. Write for particulars. John L. Steelman, Chehalis, Wash.

FLY BALL GOVERNORS—Adapted to all makes of auto engines; belt driven, flat or V. Price $6.50 prepaid. Ball bearing, $2.00 additional. Satisfaction guaranteed. In ordering state style of belt. Wm. Alber, Beatrice, Neb.

FOR SALE—Complete low priced welding and cutting outfits. Guaranteed. Soldering and brazing torches. Dependable repair service on all makes of equipment. Gasweld Equipment Co., 625 W. Jackson Blvd., Chicago, Ill.

POSITION WANTED

COMBINATION WELDER—Exp. in mtce. const., production work. Pipeline welding, gas cutting, brazing. Overhead, vertical and motor block welding. Can go anywhere. Married, age 28. Address Mar-2, The Welding Engineer.

COMBINATION WELDER AND INSTRUCTOR—Also mechanic. Member of S.A.E. Age 36, excellent ref. good habits and personality. Willing to travel. Inventor of new lt. wgt. refrigerator truck body and lt. wgt. tourist trailer and more patentable ideas. If you wish to contact industrious hard-working man that will help build your business write for full details. Address Mar-5, The Welding Engineer.

WELDING ENGINEER—Also gas and arc welder, now employed, specialized in construction work, wishes position with steel home construction corp. offering advancement. Will travel. Address Mar-3, The Welding Engineer.

WELDER—6 yrs. exp. in gas and electric welding, flame heat-treating, machine flame cutting, inspecting and thermit welding. Also familiar with drafting work. Age 28, married. Address Mar-4, The Welding Engineer.

ARC WELDER—Age 27. Graduate Milwaukee School of Engineering. 1 yr. exp. in Navy. Willing to travel. R. L. Howard, 938 N. Milwaukee St., Apt. No. 6, Milwaukee, Wis.

ARC WELDER—Limited exp. Willing to take job as helper for experience. High school and welding school graduate. Free to travel. W. Cornell, Fredericktown, Pa.

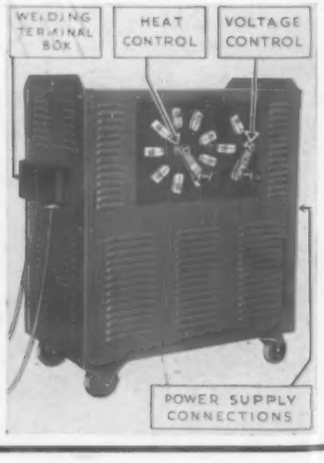
ELECTRIC & GAS WELDER—Exp. Can work from blue prints. Also exp. with trucks and tractors, both mechanical and operation, also construction work. 28 yrs. old, married and willing to go anywhere. E. L. Dalson, c/o Stanley Long, Pullman, Wash.

COMBINATION WELDER AND MACHINIST—6 yrs. exp. in job and boiler shop. Wants steady work. Willing go anywhere. Experienced in all positions. Age 24. Address Mar-6, The Welding Engineer.

WELDER—4 yrs. exp. as electric welder, also some gas welding. 28 yrs. old and married. Harvey Bub, 717 W. Atkinson, Milwaukee, Wis.

ARC WELDER—Limited exp. 20 yrs. of age. In good health. Will take job as helper to gain more exp. Can give references. William A. Barker, 170 N. Lockwood, Chicago, Ill.

COMBINATION WELDER—Age 32, married. Owns acetylene and electric portable equipment. Prefers local position. George Pastove, 517—155th St., Calumet City, Ill.

COMBINATION WELDER—10 yrs. practical experience. Light and heavy machinery, tanks, auto, boiler repairing and maintenance welding. William J. Muhne, 4238 W. Lake St., Chicago, Ill.

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